THE IMPACT OF CHANGING CARGO HANDLING TECHNIQUES ON SOUTH ISLAND PORTS

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CHAPTER I

INTRODUCTION

This study is concerned with the large and complex subject of transport planning. In particular it focusses on the problem of evaluating competing or proposed modifications to a transport system in terms of their system-wide implications. That is, the manner in which a particular course of action will affect the other components which together make up the system, is examined. Prediction of the impacts associated with any plan requires prediction of the corresponding pattern of flows which will then occur in the often multimodal transport network. To analyse a transport problem systematically a wide variety of alternatives must be studied and their differential impacts traced out.

Given that a country's (or region's) major impetus for growth stems from its ability to produce goods and services demanded by the international (or national) economy, and to market these competitively against other countries (or regions), transport facilities, by linking production and consumption centres, clearly play a distinct role in influencing both the pattern and magnitude of growth. Though it is usually realised that transport facilities are critical and basic, there is a large degree of uncertainty surrounding the effects which may follow modifications or innovations to an existing system. Such uncertainty poses real problems to the transport planner.

Like other capital goods, transport systems continually wear out and must be replaced, and additional investment may be required to keep pace with growth; certain resources must be allocated to enable its role to be accomplished in a satisfactory and efficient manner. In view of the rapid rate of technological advance currently being experienced within the transport industry, it is essential that in replacing or expanding the system due attention be taken of emerging techniques. Detailed analysis must support these investment decisions as there are usually several different ways in which resources may be allocated to the transport sector, and a country burdened with debts from an outdated transport system is hardly aided in its development ambitions.

In approaching such investment decisions it is important to realise that the demand for transport is a derived demand. That is, the level of demand for the movement of goods is derived from the demand for the goods being shipped. There is no point in merely moving products from one place to another. Bearing this in mind, it is clear that investment decisions must be made with an awareness of the objectives of the particular transport system. Although the selection of these objectives is a task for government, it must be appreciated that these decisions will have a differential impact, both spatially and in terms of groups affected. A theoretical example illustrates this point:

(i) With the introduction of new facilities into the transport system, direct savings will initially occur to the transport operator. These may be in the form

of reduced operating costs, or time savings which serve to increase the productivity of his plant. The extent to which these benefits will be passed on to the producers of goods - perhaps in the form of freight reductions or improved service - will depend upon the level of competition or governmental price regulations.

(ii) Should this improvement result in a transport cost reduction to the producer, it may enable him to compete in more distant markets - this enlarged market allowing economies of scale in production to be obtained. In addition, transport improvements may increase or decrease the relative desirability of certain locations, necessitating a producer having to relocate in order to compete.

(iii) Assuming the existence of competition, there may be a reduction in the sales price to the consumer. For some products this may lead to an increase in demand, resulting in increased production and further demand for transport.

(iv) While government itself will benefit by this increased production, it may also determine which groups will benefit from these savings in cost - by manipulating the location of facilities, its regulation policies and tax structure. Furthermore the direct expenditure of government funds on transport projects within a region will cause an immediate increase in the amount of money circulating within that local economy. This will be at least of short-term importance.(1)

Through its control over the transport system, exercised through various rate, entry and investment regulations, government has a powerful means of guiding the development process. As well as determining the location, magnitude and timing of this investment, it may also affect income redistribution. To ensure that this control is used in accordance with development objectives, it is vital that the widespread consequences which may result from changing the structure of a transport system, or the nature of transport services, be understood.

1.1 Scope of the Study

Over the past 25 years the transportation industry as a whole has undergone a technological revolution. Many major innovations affecting every facet of the movement of goods and passengers on land, sea and air - for example, the jet aircraft, the diesel engine, the intermodal movement of containerised freight, the automated ship, and the divided highway system - have been introduced. As several authors have noted, the problems generated by the introduction of technological change are among the most difficult of those confronting modern industrial society (see Levinson, et.al., 1971). A recent study which developed a number of concepts of fundamental importance to the understanding of technological change, concluded that "... the so-called "problem of technological change" resides less in technological change, per se, and more in the effect or impact of technological change..." (Gannon, et.al.,1966,4). Gannon found that the effect of technological change has not been a primary area

of research, and where the effects have been considered, the treatment has been narrowly constrained within disciplinary boundaries.

In evaluating technological projects a key issue is the differential incidence of impacts. Thomas and Schofer (1970) examined and analysed the processes used to make decisions about alternative transportation plans. They stated and discussed fundamental concepts associated with plan evaluation, described relevant criteria that might be used in such evaluation, identified problems associated with present evaluation techniques, and proposed some practical solutions to these problems. Their study emphasised that "... decisions about alternative transportation plans must be based on the probable impacts of the various choices..." (Thomas and Schofer,1970,2).[2]

One sector of the transportation industry which has been subject to widespread and substantial technological innovations during recent years, is the maritime industry. Far-reaching changes in methods of handling cargo in ports have, and are, taking place. The transport of goods in containers or other unit loads, over land, through ports and by sea has become increasingly common. Ships have had to be fitted out to carry containers or to enable cargo to be loaded by the roll-on/roll-off principle, and the equipment and organisation of ports have also had to be improved. Although a number of studies have investigated the impact of these cargo-handling innovations on shipping - especially in regard to increasing efficiency and improving service - less

attention has been focussed on the system-wide implications of such technological changes, a point noted by Forward (1970,187). The introduction of cargo handling systems - such as containerisation - as well as directly affecting the distribution function, also affect the economy within which the distribution system operates. In evaluating such systems it is necessary to examine both the impact on the distribution system and the broader impact on the economy in general. Some of the important repercussions stemming from recent cargo handling trends have been examined by Evans (1969), who reported on how some countries solved associated problems in the field of port organisation and dock labour.

Many of these cargo handling innovations are leading to the concentration of traffic through a reduced number of ports. While the immediate effect of this reduction in port activity is redundancy in capital investments, Ogundana(1970, 178) suggests that the impact of the declining port functions on the economy of the port town and its region is much more significant. He forecasts that with this tendency towards port consolidation will come a similar regional concentration of economic phenomena - population, industries, transport facilities and employment opportunities.

A review of current literature suggests that little detailed research has examined the probable system-wide impacts of cargo handling innovations within the transportation industry in general, and the maritime industry in particular. While the amount of literature has expanded with new developments, (and articles analysing and describing shipping

innovations abound), studies of the more far-reaching consequences of these developments are scarce. In this research an empirical study is made of some of the wider (or so-termed "socio-economic") implications of certain rapidly expanding cargo handling techniques. Specifically, the ramifications of the introduction of unitised cargo handling methods are examined in terms of their possible impact on a group of New Zealand ports and their adjacent economies.

1.2. Transportation and the New Zealand Economy

Being an integral part of the production process, transportation has a direct bearing on any country's economy and development prospects. As an island nation, New Zealand is completely dependent on shipping to transport the bulk of its products to overseas markets and to import the equipment, raw materials and machinery necessary for the development of its industries. Considering the degree to which the country's economic well-being is related to overseas trading activities, and the isolated position it occupies in relation to its major markets, the need for an efficent transport system can be seen as imperative.

Some basic statistics illustrate the importance of the transport industry in New Zealand. Data presented to the Royal Commission on Containers (1972) indicate that in 1970 approximately 30 percent of New Zealand's total capital investment was in transport plant and equipment - a total of $3,200 million.[3] During 1970 alone $350 million was directed into providing new facilities for this industry, and a further $1,120 million was absorbed in operating expenses.

As well as performing a vital service, the transport sector is an important industry in itself, as is shown by the fact that in 1970 it employed 14 percent of New Zealand's total labour force.

Considering the substantial investment in transport, and the magnitude of annual freight payments, it is surprising that comparatively little research has investigated the efficiency of this sector. However during the past decade several factors have contributed towards the focussing of greater attention on the overall performance of the industry. Finance for capital investment became harder to obtain and this, combined with the increasing cost of transport improvements, resulted in a more detailed appraisal of proposed developments. With New Zealand's major exports facing depressed prices on many world markets, areas in which costs could be reduced were sought. A more intensive examination of the complete distribution system linking producer and consumer - a system greatly influencing the country's production and marketing cost structure - eventuated. Finally, overseas shipowners seeking an improved return on their invested capital, initiated several studies to examine the efficiency of existing cargo handling methods.

1.3. Transport Planning in New Zealand

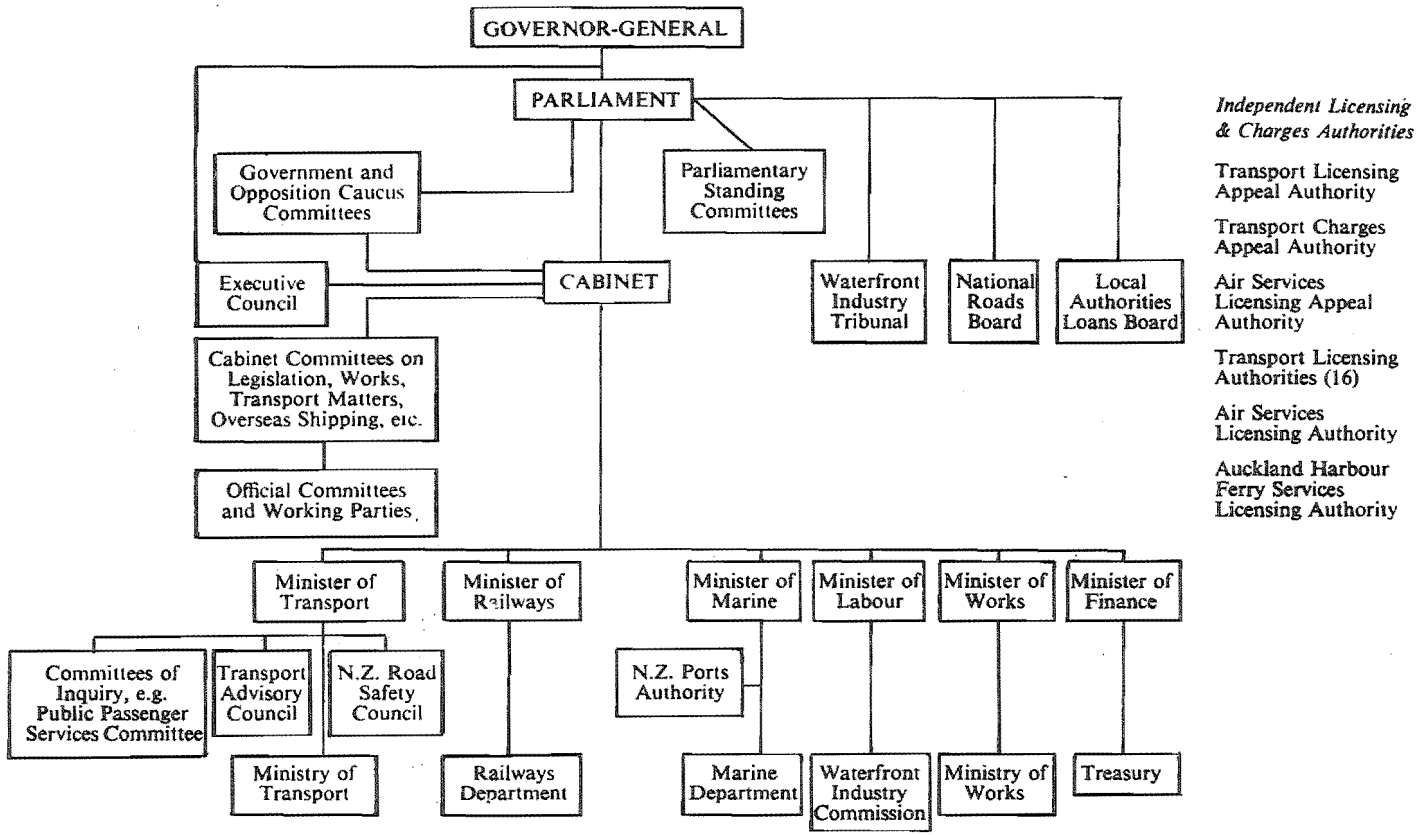
As the Secretary of Transport recently commented, "...the present administrative machinery through which Government formulates and administers its transport policy is extra-ordinarily complex..." (Polaschek,1970,506). To illustrate this complexity the main Government institutions involved in

the planning and administration of transport within New Zealand are presented in Figure 1. In addition to these numerous institutions, other organisations and pressure groups combine to influence transport decisions. These pressure groups include Producer Boards, Shipping Lines, Labour Unions and Harbour Boards. Moreover Commissions of Inquiry are periodically appointed to investigate specific matters.

Although there have been a number of definitions of "planning", that of De Salvo (1971,2) captures the essence of most definitions. He viewed planning as "... a formal or ordered process in which men seek by forethought to affect action so as to bring about more desired states than it is anticipated would otherwise occur...". In discussing the planning of New Zealand's transport system, and in particular its ports, national transport objectives must be kept in mind. The Ministry of Transport (1969,5-6) has formulated a range of goals which the transport system should aim to attain:

> "In the broadest sense the objectives ... would be the increase of industrial and agricultural productivity and consumption per head of population, ... and the promotion of regional development to the extent that government has decided that there should be a particular pattern of regional development and location of industry."

More specific objectives were also presented including: an increase in the standard of service; reduction in operating costs; reduction of cost to the user; increased accessibility to centres of production. As the Ministry of Transport (1967,7) pointed out, many of these goals may be conflicting and difficult to quantify.



Source: Polaschek (1970,508)

Figure 1 Government Institutions Involved in New Zealand's Transport Administration

Control over developments within the shipping industry, (as expressed through port activities), is held by two government organisations. In the Ministry of Transport Act 1968, the functions of the Ministry are outlined:

"Section 4 (2) ... the Ministry shall have the following functions:

(a) It shall be responsible for advising the Minister on the development of an efficient transport policy for New Zealand.

(b) It shall undertake research into all aspects of transportation, including the economics of the various forms of transport, whether by road, rail, sea or air.

(c) It shall be responsible for advising the Minister on investment in transport whether by road, rail, sea or air ..."

Clearly the evaluation of alternative cargo handling techniques, as they might affect New Zealand's port system, would fall within its jurisdiction. But even more specifically these responsibilities are afforded to the New Zealand Ports Authority. Under the terms of the New Zealand Ports Authority Act of 1968, its functions are described as being:

"Section 11 (1)

(a) To foster an efficient and integrated ports system for New Zealand;

(b) For that purpose, to prepare ... a plan ... for the development of ports and harbours in New Zealand.

(3) In the exercise of its functions the Authority shall have regard to -

(a) Internal transport, ship design, cargo handling, and likely developments in these and related matters;

(b) National, regional, and local economic and transport planning."

Both these acts clearly demonstrate that Government has recognised the need for some form of control over transport investment.

Since 1964 several studies have endeavoured to determine the most efficient method of shipping New Zealand's exports and imports.[4] Their conclusions were, in principle, very similar. They emphasised the need to achieve a faster turnaround of ships on the New Zealand coast and greater efficiency in cargo handling, and suggested the establishment of a limited container service between New Zealand and the United Kingdom. Following the completion of an independent study, the Transport Commission who had been charged by the Government to report on the benefits to New Zealand resulting from such a container service, recommended that "... the early introduction of a container service will in the long term be in the national interest of New Zealand..." (Transport Commission,1969,43).

Despite these reports many doubts still remain as to whether this form of unit loading is the cargo handling system New Zealand should be attempting to develop. While objections are often regarded as merely reflecting parochial or sectional interests, it is dangerous to dismiss many of the points raised so lightly. Many transport organisations are uncertain of the implications of the container system. This is illustrated by the following remit which was discussed at a recent Harbours Association Conference.

> "That, with the impending introduction of containers to New Zealand's overseas trade, and the necessity for ports to plan for such trade, the Government gives urgency to -
>
> (i) the designation of further container ports for the European trade, in addition to Auckland and Wellington;
>
> (ii) the determination of policy as regards aggregation of container cargoes, and;
>
> (iii) the effects of the introduction of the container system upon the smaller ports". (Harbours Association Conference, 1971, Remit 7).

An extremely relevant implication is made in the above quotation: that the Transport Commission, in reaching its decision to give approval to the container system in principle, was not aware of the repercussions their decision could have on New Zealand's port system. Neither was it aware of the method to be used for the internal aggregation of container cargoes.

Following pressure from many harbour boards, the New Zealand Ports Authority undertook a study to determine the impact the containerisation of the New Zealand - United Kingdom trade might have on certain ports. To determine this impact details of likely container aggregation methods and patterns were required. However in the Report of the New Zealand Ports Authority (1971,12) it is stated that "... information on these proposals has not been forthcoming and it has therefore not been possible for the authority to attempt to make an assessment of the likely effect of cargo aggregation on ports".

1.4. Statement of the Problem and Approach

Important technological developments are occurring within the maritime industry and the traditional methods of shipping New Zealand's import and export cargoes are predicted to undergo marked changes in the near future. A review of the recent history of port investment planning within New Zealand suggests that frequently decisions are reached without an awareness of probable or possible system-wide repercussions. With many shipping proposals involving the aggregation of traffic through a reduced number of ports, it is considered

that in evaluating such proposals, account should be taken of:

(a) the effect on total internal aggregation costs,

(b) the effect on the national port system and the economic viability of particular ports,

(c) the regional socio-economic implications which may result from ports gaining or losing trade.

The aim of this study is to examine recent port investment planning in New Zealand, and to demonstrate an approach whereby alternative shipping proposals may be evaluated in terms of the possible impact they may have on inland transport costs and on a group of ports and their adjacent economies. The characteristics of several developing cargo handling systems are described so that their effect on ports, (in terms of special facility requirements), may be appreciated.

The problem is one of predicting the impacts associated with a particular set of options. It is necessary to model cargo movements through a transport system and network analysis techniques are used to achieve this. The South Island's transport system is abstracted as a network, consisting of a set of nodes and links, with relevant cost and capacity values being assigned to the nodes and links. By changing these values it is possible to represent alternative cargo aggregation schemes, and to compare these schemes in terms of total internal transport cost.

This approach enables cargo flows through particular ports under the different aggregation systems to be

determined. To enable the impact of this cargo loss or gain on the economic viability of certain ports to be predicted, a detailed study is made of the revenue accruing to ports through its handling of different commodities and trades. By tracing the flow of this revenue out into the local economy, through the purchase of goods and services, an estimate is made of the regional economic implications associated with various shipping proposals.

Throughout this study every possible precaution has been taken to ensure that the data forming the basis of the evaluation procedure is the most reliable and accurate available. Much data was drawn from government and local body publications, supplemented by unpublished material held by harbour boards and other organisations within the transport industry. Within the body of the text data sources have been acknowledged and, where appropriate, the actual data used in the analysis included in the Appendix.(5) In evaluating alternative cargo aggregation plans the basis for comparison has generally been the transport charges incurred. While there is undoubtedly a strong case to be made for using data reflecting costs, rather than charges, the task of obtaining the precise costs involved in maintaining and operating certain portions of the transport system would have formed the basis of a complete study in itself and for this reason proved impractical. Permission to collect data was not granted by some organisations who viewed information which may have held commercial value as strictly confidential. In such cases estimates had to be calculated.

1.5. Organization of the Thesis

The thesis is organized into seven chapters. Following Chapter I which provides an introductory overview of the study, Chapter II examines some of the economic forces which, particularly in the past decade, have contributed to rapid technological developments within the maritime industry. Characteristics of new cargo handling methods are discussed and the probable impacts of these techniques on the spatial structure of the country's port system, and on the physical nature of individual ports, are suggested.

Recent studies which appear to have influenced and guided the development of New Zealand's transport system are reviewed in Chapter III. Attention is focussed on port investment planning, the objective being to examine the mechanisms of investment appraisal. In particular, major decisions are studied to determine the extent to which probable impacts associated with certain proposals were considered during the evaluation process. Objections to the Government's decision to approve the container principle are reviewed.

Chapter IV presents a method of estimating, in quantitative terms, the impact of ports on the functioning of their adjacent economies. Using this method, an empirical study of the impact of certain South Island ports is made. This analysis allows the broader implications of changes in shipping technology, which may lead to the concentration of cargo through a reduced number of ports, to be quantitatively assessed. The remainder of the chapter examines the revenue generated by particular cargoes at various ports, and a series

of income multipliers are calculated to assess the indirect impact of shipping policies on regional economies. A number of cargo aggregation schemes are studied in terms of their differential port impact.

Network analysis techniques, which are used to generate alternative internal cargo flow patterns which may accompany developments within the shipping industry, are outlined in Chapter V. Commodity flow patterns of wool and frozen meat are generated to demonstrate the impact several cargo aggregation proposals may have on internal transport costs.

Chapter VI investigates current trends in New Zealand's coastal shipping industry and the changing role played by rail and coastal shipping within the national transport system. The ramifications to ports of these emerging trends are noted, and the feasibility of introducing a coastal shipping container feeder system discussed.

The study's overall findings are reviewed in Chapter VII and future developments within New Zealand's port system are predicted. Some areas of critical importance to the efficient planning of transport investments within New Zealand, on which further detailed research is required, are identified.

Footnotes

(1) This is based largely on an example presented by Roberts (1966). Wilson(1970,46-50), also presents three theoretical examples of the effects of improved transportation, in order to indicate the diverse possibilities.

(2) Their study, which contains a most extensive bibliography, provides an excellent description of approaches which may be used to identify a comprehensive set of impacts which appear relevant to transportation choices.

(3) Further background statistics are provided by Geddes(1971).

(4) These studies are reviewed in Chapter III.

(5) Some confidential data was supplied on the understanding that it would not be released or published in any form.

CHAPTER II

SHIPPING DEVELOPMENTS : TRENDS AND IMPLICATIONS

A full appreciation of the underlying forces which have led to recent developments within the shipping industry and the nature of these developments is necessary in order to estimate their likely ramifications on New Zealand's port system. The changes which have occurred in shipping and cargo handling operations over the past two decades have been so widespread that not only have the physical characteristics of ports and the nature of port operations been greatly affected, but the philosophy towards port development has also changed. As Ordman(1971,1) points out "... the concepts of obsolescence and flexibility are now firmly fixed in the minds of port planners...".

2.1. Recent Shipping Developments

The extensive changes that have recently occurred within the maritime industry have received widespread publicity. For example, the rapid growth in the size of oil tankers and bulk carriers, the introduction of the Marconaflo system (a slurry process for the loading and discharge of iron ore), the development of the first LASH ship followed by the SeaBee system, and the introduction of gas turbine powered container ships, have all captured public attention. These innovations are for the most part related to the trend towards the application of the systems approach; they reflect an awareness that the ship is only part of a broader transportation system. A comprehensive summary of modern developments in sea transport is given by Stevens(1971). This chapter will concentrate

only on the implications of innovations within the general cargo trade.

Underlying many of the cargo handling changes which have occurred within the general cargo trade is the "unitisation" concept - unitisation being the combining of individual packages of goods into larger, more compact units, which can then be handled as one. This concept is based on a very simple notion: the more times a product is handled, the greater its final price will be. If this handling, which is an expensive, labour intensive process, can be reduced, then so should the commodity's final price. It is relatively cheap to move goods in large and uniform quantities, but when cargoes of assorted shapes and weights are moved from a number of origins to a number of destinations, the opposite is the case. With unitisation economies also result from the speedier flow of goods during the distribution sequence. It is ironical that until recently many of the more valuable cargoes have been shipped by means less efficient than have been employed for less valuable cargoes - such as coal or grain. An important feature of recent shipping developments is that these much more valuable goods are able to be moved by methods more nearly approaching bulk carriage, instead of individually in packages, sacks or cases, as was the case in the past.

The use of containers is one method by which this unitisation concept may be applied. Although a container may be regarded as being "just a box", it is a precision designed and built unit of transportation. The intermodal

container is specifically designed to facilitate the movement of one or more commodities by several modes of transport without intermediate reloading. The term "containerisation" refers to a transport system in which cargo is unitised, secured and transported within containers of set dimensions equipped with standard material handling and securing fittings, to provide for compatibility and interchangeability between different transport modes.

The volume of literature on containerisation has expanded rapidly in the last few years; indeed there are now a number of periodicals devoted exclusively to the topic. Comprehensive descriptions of this cargo handling system, including its advantages and disadvantages, are given by Cole(1971), Evans (1969), Forward(1970), Johnson and Garnett(1971), McAllum (1971), Miller(1970), the Transport Commission(1969), and the United Nations(1970).

While the concept of intermodal transportation of goods in units of the same size and configuration dates to the nineteenth century, the containership phenomenon was not introduced until the late 1950's. This was on two services - the Matson container service from the West Coast of the United States to Hawaii, and the Sea-Land service from the East Coast of the United States to Puerto Rico. At the time of their introduction, the maritime industry looked upon the container as an inefficient and unjustifiable shipping vehicle. This was because the introduction of containers would require large capital expenditure on containers, ship conversion, and terminal modifications. At the same time, the container itself used up weight and space that could be

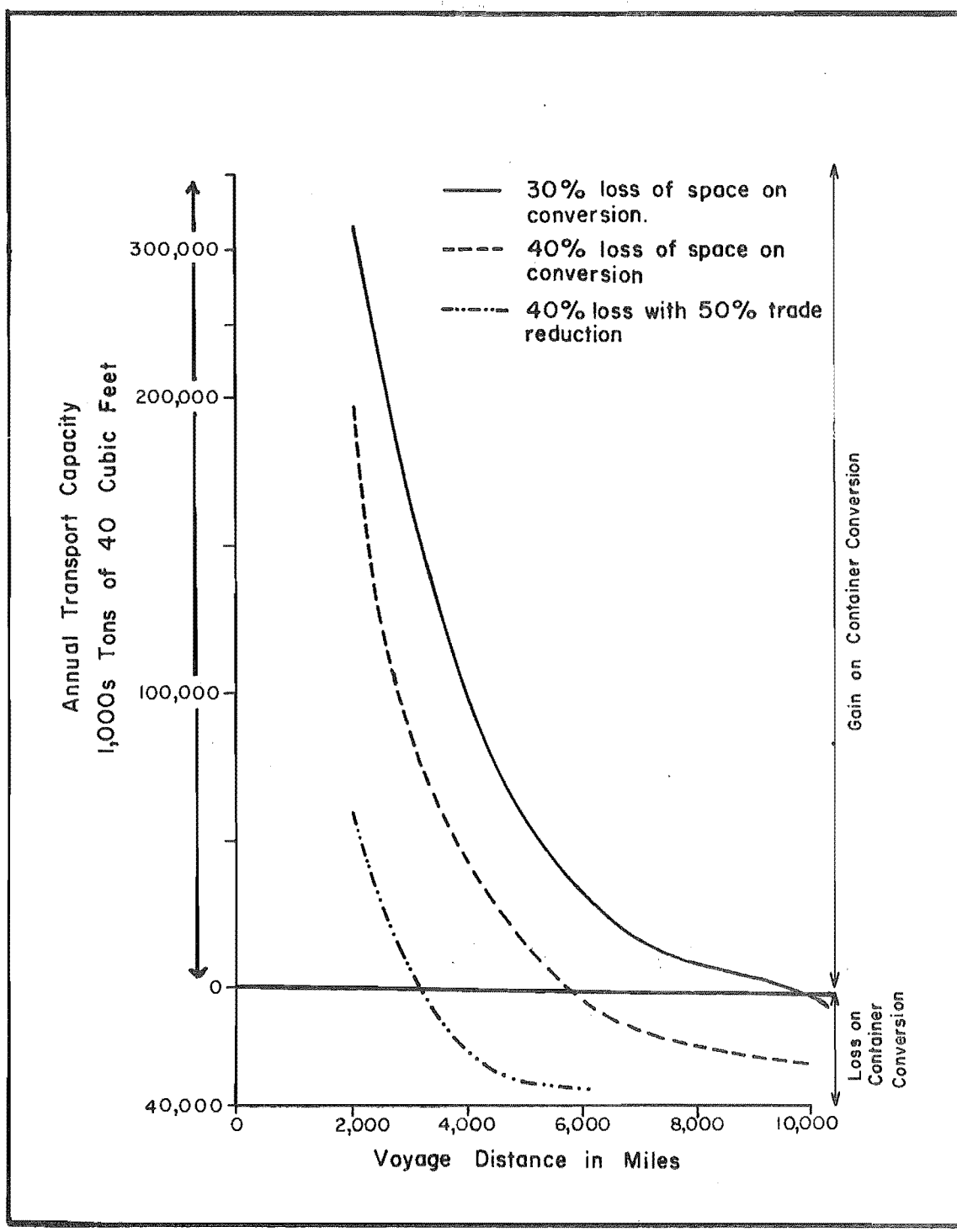
better used for revenue payloads. Crake(1963,30) expressed many of the doubts held by shipping operators when he asked:

(i) Would the saving in handling justify the extra capital tied up in the system?

(ii) How can it be ensured that one component does not incur higher costs for the benefit of the other parts of the system?".

Accepting that a principle of the container system is that cargo space may be sacrificed if ship turnaround is speeded up, containerisation will show maximum advantage on those routes where port time is high in relation to steaming time. Crake(1963) suggested that this was the reason behind the rapid development of the container concept in coastal shipping. To place this turnaround advantage in proper perspective he calculated the loss in revenue-earning space which would occur in a typical cargo liner. Assuming that there would be a 30 percent loss in effective capacity when containers are used, he found that any conceivable advantage from faster ship turnround disappeared by the time the voyage neared 9,500 miles (see Figure 2). When a 40 percent conversion loss was assumed this advantage was nullified when voyage distance reached 6,000 miles. Should ships sail with less than a full load the advantages of conversion would disappear around the 3,000 mile mark.

Many traditional shipping operators have made the mistake of evaluating container shipping from the viewpoint of the ship, rather than as an element in a larger intermodal system. Both the Matson and Sea-Land Companies took a broader viewpoint



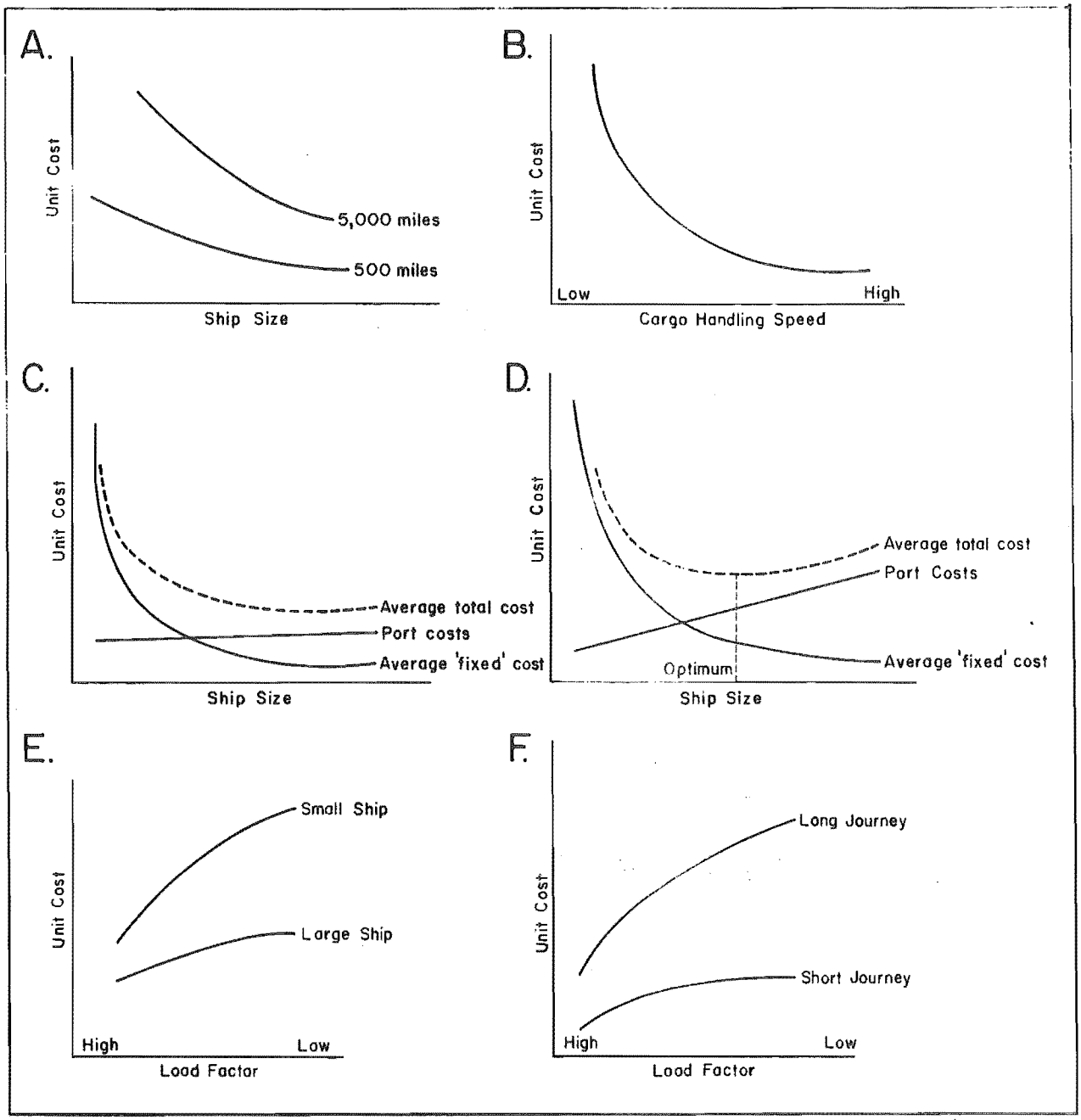
Source: Crake(1963,31)

Figure 2 Curves Showing Capacity Loss/Gain on a Variable Container Conversion Factor

and concluded that the improved productivity which could be achieved through the rapid loading and discharge of containers, and the faster service offered shippers, would more than compensate for the loss in payload and increased capital investment requirements. In recent years container shipping has experienced tremendous growth with approximately 80 percent of all the North Atlantic general cargo trade now moving in containers. Undoubtedly a major contributing factor to the success of the system has been the marked reduction in time spent in port.(1)

Studies of conventional break-bulk ship operations have shown that these ships may spend more than 60 percent of their time in port loading, discharging or awaiting cargo (Producer Boards' Shipping Utilisation Committee, 1964). The ship therefore serves a large percentage of its time as a warehouse holding cargo, rather than as a transportation vehicle delivering cargo. Introduction of the container has made it possible for an operator to load an entire ship in 24 hours, compared to the 5 - 8 days that may have been taken by conventional shipping. Similar savings are possible in the discharge process, the result being an enormous improvement in ship utilisation and in annual productivity.

Many shipping lines have heavily committed themselves to containerisation as a means of lowering their operational costs. Johnson and Garnett(1971) examined the viability of this commitment by identifying the shipping economies which can be attributed to containerisation. Their findings are summarised in Figure 3.



Source: Johnson & Garnett(1971,35-45)

Figure 3 Some Relationships Between Ship Characteristics and Unit Cost

In considering the economies of scale which may result from building large container ships, they found that while economies did result these should not be exaggerated. The savings tend to become more important on the longer trade routes, but must be weighed against reductions in service frequency (Figure 3a).

Port cargo handling rates play a major role in determining the efficiency of shipping services. Johnson and Garnett(1971,37) consider that "the growth in size of conventional general-cargo liners, and hence the achievement of economies of scale, has been effectively constrained by inefficient terminal handling methods". It is in this crucial area that containerisation makes a major contribution towards reducing costs. Figure 3b shows, for a given ship size, the rate at which a ship's unit costs will decline as the cargo handling rate increases. Potential savings in a ship's capital costs from this quicker turnround are considerable.

In tackling the question of optimum containership size, Johnson and Garnett concluded that ship size is partly a function of the frequency of service demanded; and, as service frequency is a function of route length, then optimum ship size may in part be regarded as a function of distance. A crucial element is the relationship between port costs and ship size, and the authors could not resolve whether or not larger container ships involve higher port unit costs. Two relationships are shown in Figures 3c and 3d. It can be seen that there is only an optimum ship size, in terms of the variables specified, should port costs rise very rapidly as ship size increases (but the exact relationship between ship

size and port costs must be known before any definite size may be suggested as being optimal).

Load factors are a further variable determining unit costs. While low load factors increase the costs, the rate of increase is less in the case of large ships, as their fixed costs form a smaller proportion of total costs (see Figure 3e).[2] As demonstrated by Figure 3f, unit costs are more sensitive to variations in the load factor over longer distances.

Containerisation is just one example of the unitisation concept, (though the most elaborate), and other unitisation methods have their supporters. Indeed it seems as though for every article or report supporting containerisation, there are an equal number pointing out its disadvantages, or the advantages of palletisation or some roll-on/roll-off cargo handling system. Miller (1970,190) feels that many operators may have entered the container system placing "... more emphasis on haste rather than thoughtful development...", and in his comprehensive paper illustrated the tremendous depth of detailed analysis which must be completed before arriving at any firm conclusions regarding the "optimal" system.

There have not been many detailed studies evaluating the economies of alternative shipping technologies. However one of the most detailed and thorough examinations found by the author was a study by Getz, Erichsen and Heirung(1968).[3] They compared the construction, operating and cargo handling costs of two unitised cargo systems, pallets and cellular

containers. Although it must be noted that their study did not take into account the service characteristics of the systems (for example, the time goods were in transit), some of their most relevant conclusions are listed below:

(i) "A comparison of cost and capacity of ship and shore-mounted gear shows that lifting equipment should be shipborne, both when handling loose cargo and pallet loads. The most economical lifting gear for containers are shore-mounted gantry cranes, due to their better utilisation ashore and their adverse effect on payload and stability when mounted aboard. The best cargo gear for pallets is combined side door/side hatches and pallet elevators, no lifting gear ... being required.

(ii) The most economical system (is) door-to-door pallets ... even port-to-port pallets giving less costs than the port-to-port leg of door-to-door container. (This is in terms of shipping costs only).

(iii) ... for cargo originating at moderate and long distances from the ports, containers are advantageous, whereas pallet loads will be the economic form of unit loads for cargo shipped from places within the port and its adjacent hinterland". (Getz, Erichsen and Heirung,1968,21).

In arriving at their final conclusion the authors assumed that the internal movement of containers may have the benefit of special low-cost unit trains. The minimum inland haulage, necessary to make container costs break even with the pallet costs, varied according to the round-trip length and whether the container was broken down before delivery to the consignee. (Assuming a round-trip distance of 14,000 miles, and no break-down of the container before delivery, a minimum internal haul of 204 miles was necessary for the container to match the pallet system. It was further assumed that the container ship called at only one port at either end while the pallet ship called at three).

Although these findings do not necessarily apply to the New Zealand situation, the above points deserve consideration.

Perhaps Miller's statement to the effect that "too much haste and not enough thought" has characterised the entry of some operators into the container system, contains an element of truth. Ports may be rushing to invest in container facilities for no other reason than the fear of being left behind.

2.2. Impact of Shipping Developments on Ports

Technological evolution in shipping has confronted both shipping companies and port authorities with new shipping dimensions. Viewed in retrospect, the extensive changes that have occurred within the shipping industry over the last two decades have been dictated in the main by the economic necessity to derive the benefits of economies of scale and to reduce "idle-time" spent in port. The main characteristics of these changes are:

(i) a very large increase in ship size, both in length, beam and draft, particularly in bulk carriers and tankers;

(ii) the development of unit-load systems and specialist ships related to these systems;

(iii) integrated transport systems wherein the sea and land-legs are treated as complementary parts of one system, the port being the integrating link.

These three features have developed simultaneously and their combined effect on the physical characteristics of ports, as well as on the nature of port operations, has been marked. Reference to some New Zealand developments will illustrate these effects.

Impact on New Zealand Ports - Evidence of the impact of these shipping developments on New Zealand ports is readily

apparent. Traditionally these ports have concentrated on providing berths suitable for vessels ranging in size from the small coaster to the large general cargo vessel or even bulk carrier. In consequence, existing berths were mainly built for general use as opposed to being designed specifically for a particular type of vessel. The changing role of New Zealand ports, insofar as the provision of facilities is concerned, is now clearly evident with the increased accent on design for individual vessels, commodities or trades. For example, many ports have built specialised facilities for oil tankers; a bulk cargo wharf, principally for the loading and discharge of fertiliser, has been completed at Whangarei; storage and related equipment to handle the export of wood pulp through Napier are being designed; bulk lucerne silos have been constructed at Picton; Nelson has installed specialised pneumatic loading facilities for a wood-chip trade; recent developments at Timaru include the provision of bulk handling installations with a storage capacity of 6,000 tons and maximum designed ship loading rates of 2,000 tons per hour; all-weather mechanical meat loading facilities have been built at Timaru and Bluff, and a specialised wharf to serve New Zealand Aluminium Smelters Limited has also been constructed at Bluff. This wharf is 650 feet in length and has a 4,120 foot approach. A bulk discharger has been installed which feeds a belt conveyor to silos ashore.

Facilities for roll-on/roll-off vessels are now common, with eight stern-loading berths having been built and several more being planned. Major developments have occurred at

Auckland and Wellington in keeping with their designation as New Zealand's container ports. A container terminal has also been completed at Otago.

New Zealand's first Single Point Mooring Buoy, a revolutionary development, commenced operations in July 1972. Located 1.3/4 miles offshore from Waverley, this system loads ironsand in slurry form aboard special 70,000-ton tankers at rates exceeding 1,500 tons per hour. A second offshore ironsand concentrate loading system has been constructed at Taharoa. New Zealand Steel Limited intends to export 1,200,000 tons of ironsand concentrate annually through this terminal.

With the marked increase in vessel size, many New Zealand ports have major development programmes underway to increase their harbour and channel depths. The ports of Tauranga, Taranaki, Nelson, Otago and Bluff are all in the midst of such programmes: development dredging at Tauranga is aimed at increasing the maximum permissible draught from 28½ feet to 32 feet to enable ships to uplift full log loads; following a disastrous storm in April 1968, a major dredging programme had to be commenced at Nelson as a matter of extreme urgency to facilitate the export of wind-thrown logs to Japan; Otago is improving its lower harbour channel depth to 33 feet (low water) to enable container ships of maximum Panama Canal dimensions to be berthed at practically all states of the tide and weather; to accommodate larger vessels associated with the aluminium smelter, a project to widen and deepen the entrance channel was necessary at Bluff. Similar development

programmes are being considered at Lyttelton and Timaru. Even Wellington, which enjoys a controlling entrance depth of 49 feet (chart datum), feels that it may have to deepen its entrance channel to accommodate the larger oil tankers and container ships anticipated to be in service within the near future.

Total berthage length can be expected to remain static, or even decrease, at most New Zealand ports as a result of the widespread introduction of unitised handling methods which greatly increase the capacity of a single berth. For example a roll-on/roll-off berth may handle in excess of 400,000 tons annually - the average annual throughput of a conventional berth is 135,000 tons. These handling methods are leading to the review of wharf design standards, as vessels requiring the use of high axle load plant will need to be accommodated. Recently constructed wharves, such as the Cashin Quay complex at Lyttelton, have been built to very heavy design standards, providing for maximum axle loadings from mobile plant of 50 tons.

Whereas total berthage length may remain static, there is little doubt that ports will be required to provide increased land areas adjacent to berths for the marshalling and aggregating of cargoes. Faster cargo movement between ship and shore will result in congestion, and a resultant reduction in handling rates, unless delivery to and from the loading area is similarly increased. Many New Zealand ports are unable to handle unitised cargo at optimum rates of efficiency because of congestion on old-type finger piers and lack of sufficient off-wharf pre-assembly areas.

To maximise the benefits to be gained from faster cargo handling methods it is clear that good road and rail access to the ports is also vitally important. The improvement in the ability of inland transport to handle unit loads has been an essential factor in the success of the container system.(4)

Impact on Port Systems - As well as affecting the physical characteristics of individual ports, shipping developments play an important role in influencing the structure of a country's port system. The planning of an optimal port system is complicated by the fact that little is known about the theory of the forces influencing the spatial arrangements of ports. Though it is generally agreed that ports pass through certain phases of development, it is difficult to predict where this development process may end.

Rimmer has given this question considerable attention. He postulated on idealised-type sequence of port development, which although theoretical, does mirror some of the changes which have occurred within New Zealand's port system. Port development is seen as passing through the following stages:

> "The first phase consists of a dispersed pattern of seaports scattered along the coast serving limited hinterlands. Except for irregular visits of trading vessels, there is little interconnection between the ports. With the emergence of the main lines of (inland) penetration - phase two - the concentration of shipping services is intitiated, as some ports expand at the expense of others. Port concentration is accentuated as these ports develop as foci of feeder routes. The feeders continue to develop until these ports are linked together by the growth of landward connections (phase 3)." (Rimmer,1967a,89).

In Phase 4, Rimmer sees the ports occupying central positions expanding by pirating the trade of neighbouring ports.

Similar trends can be recognised in the growth of New Zealand's port system.(5) The nature of the topography meant that early settlements were largely confined to coastal areas and many settlements depended upon their port as their only means of communication, both with overseas countries and the rest of New Zealand. High inland transport costs gave ports an element of local monopoly and consignments tended to move through that port closest to the shipper. As inland transport has become more efficient and relatively cheaper this situation has changed. Shipping lines are now concerning themselves with the complete door-to-door movement of consignments and shippers often find that they can operate just as cheaply and conveniently through a relatively distant port as through a local one.

Changes in the technology of both maritime and land transport are clearly both important factors in determining the structure of any port system. The increasing size and specialisation of ships, the use of capital-intensive automated handling systems and the trend to unitisation of cargoes have created a situation in which a fundamental aim of the shipping industry is the minimisation of time spent in port. Robinson (1970) sees a move towards rationalisation of shipping movements through port networks, and the reduction in number of ports serviced, as inevitable.(6)

A significant characteristic of unitised cargo handling systems is the very high cost of the terminal and mechanical handling equipment. An obvious implication of this is that, in order to achieve acceptable unit costs for the port operations, berth throughput must be very high. Individual ports will be anxious to invest in these facilities for as

Garnett (1970,413) points out, "... the dominant factor determining the attractive power of a particular port (will) no longer (be) its proximity to a particular shipper, but whether or not it can cope with large vessels which reap economies of scale...". The need for a country to control such investments, rather than permit a number of under-utilised facilities to be built, is apparent.

2.3. Port Investment Planning

In 1960 Thorburn (1960,140) stated that "large investments in harbours throughout the world appear to be made to a large extent intuitively and not on the basis of rational economic calculations. Practically all the investments made ... are made on the basis of very imperfect investment calculations...". The technological evolution in shipping since that date has required very large investments in port facilities. This section briefly reviews some of the methods used to evaluate alternative port investments.

The purpose of investment appraisal is to measure the costs and benefits of a project in order to determine whether its net benefits are equal to those obtainable from other investment opportunities (Adler,1971,3). A number of mathematical methods have been developed specifically for the comparison of capital investment proposals (these methods are reviewed by Adler (1971,40-51)). Practical applications of these techniques to port and shipping investment decisions are demonstrated by Brown (1971), Cambon(1971), Goss(1967a, 1968,1971) and Mills(1971). While evaluation methods have been refined to the point where the discounted return on an

investment can be calculated to a fraction of a percent, these authors point out that because calculations must be based upon data estimates which are not nearly so accurate, this kind of precision is only illusory.

Problems still to be resolved in evaluating port investments include: forecasting the volume of traffic likely to be generated by the provision of a facility - a vital input to the pricing analysis; selecting a method of depreciation which accurately reflects the decline in the economic value of an asset, choosing appropriate prices which will adequately value the benefits flowing from the services provided by the investment; defining the real costs and benefits.(7)

General purpose port simulation programmes have been developed to compare the costs of a number of different port systems, and many of these programmes are reviewed by Agerschou and Korsgaard(1969). Robinson(1970) has formulated a computer programme to evaluate investment allocation and operational efficiency in an individual port, but notes that further research is necessary before his method could be extended to the multi-port situation. Current research on multi-port investment allocation has been described by Gulbrandsen(1970,85-95). Solutions to the problem of determining through which of a number of ports cargo should move, the timing of investments, and the type of investments required in ports and inland transport systems in order to minimise transport costs, are discussed.

Footnotes

(1) Goss (1968,153) has shown that if the proportion of time spent in port by cargo liners (around 60 percent of their time), could be reduced to 20 percent, the cost of sea transport in a cargo liner could be reduced by between 18 and 35 percent, depending on the route length. Obviously, with such a high proportion of completely non-

productive time in port, considerable improvements in ship productivity could be achieved even without containerised handling systems.

(2) Container-shipping unit costs are particularly sensitive to reductions in load factors as capital is tied up in the containers themselves, which often have to be carried even empty to maintain a balanced flow of shipping space (Johnson and Garnett,1971,46).

(3) Similar comparative studies have been undertaken by Benford(1971), and Little(1970).

(4) Despite the identification of apparent trends, extreme caution is still necessary as the exact course shipping developments will take is still uncertain. With regard to predicting these developments Ordman(1971,1) commented that "... in the course of the last 20 years, the only reasonable certainty in forecasting has been that our forecasts will be seriously misleading...".

(5) A concise summary of the forces leading to these charges is presented in the Report of the New Zealand Ports Authority (1970,3).

(6) Examples of this tendency towards port concentration are well documented (see Rimmer 1964, 1967a, 1972; Kenyon 1970; Ogundana 1970). Forward(1970,193) sees Australia's general cargo trade as focussing increasingly on three container ports, at the expense of other ports that have been traditional ports of call in the past.

(7) Goss(1967a) has pointed out that a discounted cash flow type of analysis often has to be rejected in the case of ports because their charging systems bear no relationship to longer short run average or marginal costs. Goss (1967a) and Garnett(1970) have suggested ways, based on a shadow price technique, by which these problems could be overcome.

CHAPTER III

INVESTMENT PLANNING FOR NEW ZEALAND PORTS

From 1960 to 1969 capital expenditure at New Zealand ports, excluding the capital requirements associated with maintaining works and services, exceeded $109 million (see Table 1).[1] Although a significant proportion of this finance, (Fluctuating between 16 and 37 percent of the total), came from harbour board income or reserves, the largest proportion of it was from public loans.

As noted in the previous chapter, Thorburn(1960) in his examination of port investments found that many decisions had been reached intuitively and not on the basis of rational economic calculations. Similar conclusions were reported by Garnett(1970), Goss(1967a) and Mills(1971). This chapter will review those studies which have had an important bearing on the development of New Zealand ports, the objective being to examine the methods of investment evaluation followed. The degree to which the probable impacts associated with investment plans were considered in reaching important decisions are studied.

3.1. Review of Shipping Studies

A number of detailed studies have been conducted to determine whether the methods of assembling, loading, shipping, unloading and delivering overseas cargo could be improved or altered to the advantage of importers, exporters, shipping companies and others involved in New Zealand overseas trade. The conclusions of each study were, in principle, very similar.

Table 1

SUMMARY OF CAPITAL EXPENDITURE AT NEW ZEALAND PORTS, 1969/1970

Year Ended 30 September

YEAR	SOURCE OF FINANCE		TOTAL
	Loan (Dollars)	Income or Reserves (Dollars)	(Dollars)
1960	6,466,770	1,235,820	7,702,590
1961	6,476,584	2,111,714	8,588,298
1962	10,418,568	2,035,474	12,454,042
1963	7,813,484	1,946,032	9,759,516
1964	7,027,656	1,732,118	8,759,774
1965	9,996,520	2,294,546	12,291,066
1966	8,353,600	2,491,710	10,845,310
1967	10,633,294	3,066,929	13,700,223
1968	8,892,621	5,150,355	14,042,976
1969	8,027,239	2,983,704	11,010,943

SOURCE: Local Authority Statistics, 1959/60 to 1969/70. Department of Statistics, Wellington.

They all emphasised the need for the faster turnround of ships on the New Zealand coast and improved efficiency in cargo handling. These studies have greatly influenced the nature of investment at individual ports, and the overall allocation of investment between ports.

The first of a series of investigations into the efficiency of current shipping practices was the "Streamlining Report" issued in 1964 by representatives of the New Zealand Producer Boards and the British Conference Lines.(2) To implement their recommendations - which centred on rationalising the loading and discharging of particular ships at no more than two ports, to reduce time spent by ships on the New Zealand coast - they urged the formations of an Exports and Shipping Council consisting of representatives of all parties directly interested in New Zealand's export trade. This Council was duly formed but has not been completely successful in securing the implementation of the Report's recommendations. The Report also suggested that a Transport Commission should examine New Zealand ports and all road, rail, air and coastal shipping services, with a view to preparing a National Plan to guide future port development. A Transport Commission was duly appointed in July 1965.

Under its terms of reference, the Streamlining Report was confined to examining only the shipping link of the total transport system. A much broader investigation, covering all the links in the handling and transport chain, was undertaken in 1967 by the Molyneux Committee.(3) This investigation, commissioned by the British Conference Lines,

was prompted by the acceleration in the development of new cargo handling and transport techniques, the most important of these being the use of containers. The principal recommendation contained in the Molyneux Report was that a limited container service should be instituted between New Zealand and the United Kingdom by 1971. Subject to certain qualifications, the Transport Commission accepted the Molyneux Report's conclusions and agreed that the introduction of a container service should be to the mutual advantage of the British Conference Lines and the New Zealand economy (Transport Commission,1967a,9).(4)

Many in New Zealand considered that it should not be left to the Conference Lines to decide whether a container service would be in the country's best interests. As it was felt that qualified staff capable of completing the necessary study within a suitable period were not available in New Zealand, the Government commissioned an independent company to study alternative transport systems for New Zealand's West European and United Kingdom trade. The Metra Consulting Group were engaged for this task and completed their report in April 1969.

The major conclusions of the Metra Report may be summarised as follows:

(i) "The containerisation of New Zealand's trade with the United Kingdom and Western Europe will have an economic advantage over conventional and palletised systems.

(ii) The container service should be provided from either Wellington or Wellington and Auckland together in New Zealand and London in the United Kingdom.

(iii) Four ships of a capacity of 1,400 containers ... would be able to carry 66 percent of Northbound traffic and 81 percent of Southbound traffic. Thirty-one conventional ships would be required for the balance

of non-containerised traffic.

(iv) The total new investment in four container ships, containers and New Zealand port facilities would be approximately $80 million". (Metra Report,1969).

Shortly before the release of the Metra Report, the British Conference Lines outlined their container proposals in a brief brochure entitled "Towards Containers for New Zealand". In their report the Lines concluded that they were convinced of the practicability and the advantages of containerisation in the New Zealand trade. The system proposed was for four container ships to provide a 14 day service calling at Southampton or London in England and at both Auckland and Wellington in New Zealand. Each vessel would carry 1,400 containers, 1,100 being for refrigerated cargo and 300 for general cargo. The total investment involved in the service was estimated as being $107 million.

The Transport Commission was charged with evaluating these proposals and published their findings in a lengthy report in May 1969 (Transport Commission 1969). Their report provides a comprehensive summary of the Molyneux and Metra Reports as well as the proposals forwarded by the British Conference Lines, and evaluates the Lines' proposals in the light of the Metra Report. The early introduction of a container service was recommended as being, in the long term, in the national interest of New Zealand and Government was advised to give approval in principle to the Lines' proposals.

Discussion of these Studies - Considerable controversy surrounded the release of all these studies. The Metra Report has been criticised for basing some calculations on data of rather dubious value, and it has been suggested that the other

studies, being commissioned by the British Conference Lines, aimed at determining that system which would return the greatest profit to the Lines.

The Metra Report appears to have greatly influenced Government's planning in this area: the Minister of Transport has suggested that "... possibly this report will have a greater impact on our transport system than any other document previously received in New Zealand ... the Government is particularly pleased with the report ... This report probably represents the most valuable $70,000 this or any Government has ever spent". (Hansard,1969,207-8). Unfortunately it appears as though some "findings" have been attributed to this report concerning topics which were in fact outside its terms of reference. For example the Minister of Transport has also stated that "... Metra has told New Zealand what system of moving its export and import goods would cost less than any other system while giving the service we require..."(Hansard,1969,208). A reading of the Report suggests that this statement is rather sweeping. In their report Metra state that "three types of shipping have been analysed; they are conventional break-bulk, palletised and container" (Metra Report 1969,34). Certainly their study did indicate what shipping system would be the best of those examined, but as they examined only three basic systems it is unrealistic to conclude that the best system is now known.(5)

Many of the objections which followed the release of the Metra Report only served to demonstrate that the objectors had not read, or understood, the report. Several ports performed calculations to demonstrate that they should be

included as one of the country's container ports; generally savings in internal transport costs were balanced against the increased cost of having the container ship call at an additional port. These calculations failed to take into account the effect of increasing the number of ports of call on the efficiency of the total system. But the ensuing controversy did highlight one simple but extremely important fact: that the report's results would only be as valid as the data used was accurate. In this respect many harbour boards questioned the accuracy of port development capital costs estimated by Metra, and similar doubts were expressed over the reliability of inland container movement costs.

Inland cost estimates were obtained from road carriers, coastal shipping operators and the Railways Department, but in terms of the many "unknowns" - for example, the number of containers to be moved, length of haul and frequency of service required - it would have been extremely difficult for these groups to have derived accurate costings. Geddes(1971) has since indicated that much uncertainty still surrounds the manner in which railway container rates will be calculated. The rating will be influenced by: (a) whether containers are priced on a per ton or unit basis; (b) the volume and average length of haul of the traffic offering; and (c) the charges offered by competitors for the same service. For these reasons the validity of the data Metra used to reflect the costs of container aggregation must be in doubt. As the transport costs incurred in channelling cargo through a limited number of ports are a vital factor in determining the economic viability of container systems, Metra's conclusions

must be viewed with some reservations.[6]

3.2. The Role of the New Zealand Ports Authority

During the period 1965 to 1969 the Transport Commission presented a number of reports seeking to rationalise port policies, but the need for a permanent statutory authority to control port development became evident and to this end the New Zealand Ports Authority was constituted in 1968. As outlined in Chapter I, the general functions of the Authority are to foster an efficient and integrated ports system for New Zealand, and to prepare and keep under review a national plan for the development of ports and harbours. The Authority's aims are admirable as a situation was developing similar to that seen by the Rochdale Committee in their review of port investment in Britain. In reviewing the existing system of controlling investment expenditure, the Rochdale Committee noted that:

> "... there was no control of projects financed out of reserves, and that for other projects (which required increased borrowing powers) there was no independent economic test of the need for a proposed development scheme, and no attempt to relate the proposals of one port to those of another; on the contrary, so long as a port's finances are sound, the scheme is technically unobjectionable, and the cost reasonable, there will be no case for withholding approval". (Mills,1971,121).

The task confronting the New Zealand Ports Authority is a vital and major one. That all port investment proposals should be carefully evaluated may appear to be self-evident, yet many organisations fail to do this, their investment decisions appearing to be arrived at on the basis of "hunch" or "intuition". While all business decisions call for a measure of intuition, this can never be a substitute for conclusions drawn from hard facts.

Control over port investments is given by the requirement that all harbour board capital expenditure in excess of a certain sum must be referred to, and approved by, the Authority,[7] Since its inception the Authority has granted applications allowing harbour boards to raise loans to the value of $24,791,500 (see Table 2). In addition the Local Authorities Loans Board has referred a number of loan applications to the Authority for advice.[8] Clearly the formulation of a national ports plan is a very complex problem. But in the absence of such an overall port plan, one wonders at the criteria used by the Authority in granting these loan applications. As King (1971,108) has suggested, "... it is hard to see on what grounds the Authority can judge proposals ... except on an ad hoc basis with reference only to the viability of the specific project concerned". No standard economic evaluations appears to be performed in judging these applications.

Many harbour boards are concerned at the lack of a national plan which the Authority was set up to produce three years ago. An example of the frustration felt is provided by a recent comment by the chairman of the Timaru Harbour Board: "... the port of Timaru is entering into the most difficult period of its entire history. Difficult, because due to the lack of national research and co-ordinated planning the Board does not know which way it should develop."[9] There are fears that in an endeavour to attract trade larger ports will tend to duplicate expensive container and unit-load facilities, and as a result shipping companies will be in a position to play off one harbour board against another.

Table 2

LOANS APPROVED BY THE NEW ZEALAND PORTS AUTHORITY, 1970/1972

Dollars

HARBOUR BOARD	VALUE OF LOANS APPROVED(1) 1970	1971	1972
Auckland		5,500,000	
Bay of Plenty		750,000	300,000
Marlborough	2,243,000		610,000
Nelson		500,000	
Otago			1,200,000
Southland			900,000
Taranaki	2,400,000		1,430,000
Timaru	355,000	35,500	108,000
Wellington	4,810,000		3,650,000

(1) Loan Applications considered in 1970 and 1971 totalled $9,808,000 and $6,785,000 respectively. The comparable figure for 1972 was not available.

SOURCE: Report of the New Zealand Ports Authority, For the YearsEnded 31 March 1970, 1971, 1972. Government Printer, Wellington.

In reply, the Authority stresses that all current port development conforms with the national interest as represented by the national port plan being formulated (Report of the New Zealand Ports Authority,1972,11). It points out that it has full control of work undertaken from loan moneys, and in addition enjoys the full co-operation of all harbour boards in prior consultations on any works proposed to be undertaken from revenue or reserves.

The Authority has indicated that the national ports plan will be flexible.(10) In an era when technology is changing so rapidly the advantages of flexibility are obvious. Unfortunately, while a plan may be flexible, port investments are of a very fixed and long-term nature. Many port facilities, besides being immobile and having an almost infinite economic life, run the risk of rapidly becoming obsolete, and port investments, whether correct or incorrect, tie up valuable funds for many years.

While evaluating port investments per se is a difficult task, the Ports Authority must also ensure that port policy is co-ordinated with other internal transport modes. Developments within the railways system will have an important bearing on New Zealand's future port system. As the Ports Authority has no control over the actions taken by these other modes, their task is further complicated.

3.3. Reaction to the Proposed Container Service

Technological change is a continuing characteristic of modern society and the problems generated by such change continue to be among the most difficult of those confronting

society. While the introduction of new techniques may help increase the standard of living for society as a whole, De Salvo(1971) has demonstrated that "... efficiency in the use of resources does not necessarily imply equity in the distribution of resources...". Developments within New Zealand's overseas shipping service are anticipated to result in cargo being concentrated through a limited number of ports. Should this happen, some harbour boards would suffer a reduction in their total revenue receipts from the provision of works and services, and firms engaged in port-orientated activities may experience a reduction in business. The problem facing the Government is to find an acceptable compromise between the often conflicting objectives of achieving overall growth without threatening the security of any particular group or community.

Much of the discussion which followed the publication of the British Conference Lines' container proposals, and the Metra Report's findings that containerisation would have an economic advantage over conventional and palletised systems, may be attributed to the fact that no associated study had investigated the internal ramifications of these proposals. Lack of specific information indicating the cargoes to be containerised and the method of aggregation was perturbing, and many harbour boards viewed their future with considerable concern. Exercises were performed to illustrate the extent to which they may suffer under the proposed schemes. For example, the Lyttelton Harbour Board predicted that should New Zealand's United Kingdom trade be containerised under the four-ship two-port system, their port would lose approximately 100,000

tons of cargo per annum. Should the container service be extended to other trades they would lose an additional 150,000 tons of cargo, resulting in a total revenue loss of approximately $300,000 per annum. Such a drop in revenue would be "... beyond the financial ability of the Board to carry without the necessity of increasing charges on residual cargoes..." (Lyttelton Harbour Board,1969a,Appendix G). The Napier Harbour Board expressed similar fears concerning the impact of the proposed container service to the east coast ports of North America. They felt that the diversion of meat shipments through Wellington would seriously affect their revenue. To recoup these losses they anticipated that increased charges to shippers, in addition to a harbour district land rate, might be necessary (Anon.,1970d). Similar sentiments were expressed by other harbour boards (see Northland Harbour Board 1969, and Otago Harbour Board 1969).

Perhaps the fears held by many harbour boards can best be illustrated by a quotation from a speech made during the Parliamentary Debates: "If a fully cellularised container service comes to New Zealand many of our ports will become ghost ports, and their wharves concrete cemeteries. The loss of work at these ports will have a detrimental effect upon the men that service them and the towns they come from." (Hansard,1969,259). Even accepting the fact that a number of purely emotive anduninformed opinions have been expressed regarding this subject, the probable impact on certain New Zealand ports and their adjacent communities under the container system appears to be substantial. It is therefore

relevant to examine the extent to which this factor (which may be viewed as an extra "cost"), was considered during the decision-making process; both by the Transport Commission in their approval of the container system in principle, and by the New Zealand Ports Authority in their recommendation that Auckland and Wellington be developed as New Zealand's container ports.

Port Impact as a Factor in Choice - Government's decision to agree in principle to the Britich Conference Lines' proposed container service, was based largely on the Transport Commission's evaluation of their proposals in the light of the Metra Report(Hansard,1969,1129). For approximately four years the Commission had studied the containerisation concept in general and the feasibility of its introduction into New Zealand's shipping service. As recorded in Hansard(1969, 1132), the Commission also "... investigated the domestic situation and the social and economic problems that the adoption of the system might present to New Zealand".

While the bulk of their report dealt with comparing the findings of the Molyneux and Metra Reports with the Conference Lines' proposals, they did discuss the effect the diversion of cargo through Auckland and Wellington would have on other ports. Having noted that the exact impact could not be predicted until the manner in which particular cargoes were to be allocated between container and conventional ships was decided, they agreed that "... ports other than the container ports will suffer financial loss and disturbance in various degrees..." (Transport Commission,1969,40). While the Commission felt that the effects of loss of trade, both on

ports and their surrounding areas, would be "widespread", they considered such losses would not be so great as to justify abandoning the cellular container concept. No forecasts of the magnitude of these detrimental effects - either in terms of reduced earnings or employment opportunities - were made, though the Commission did recommend that claims by harbour boards for compensation should be considered.

The New Zealand Ports Authority supported the Transport Commission's recommendation (that a container service provided by four ships should serve Auckland and Wellington), and in turn recommended that Government establish New Zealand's first container ports at Auckland and Wellington. In their first annual report, the Authority stated that it had been

> "...charged with the responsibility for assessing the likely economic and social effects aggregation policies may have on ports. The Authority is presently engaged upon a study of the implications of aggregation ... giving priority to the ECNA sector which will be introduced earlier" (Report of the New Zealand Ports Authority,1970, 10).(11)

They subsequently reported that a preliminary study of the effect of shipping the East Coast North America trade through only Auckland, Wellington and Port Chalmers had indicated that ports from which trade was diverted would not be detrimentally affected to any major extent (Report of the New Zealand Ports Authority,1971,8). The details of their findings were not released. At the same time they reported that as the British Lines' container aggregation pattern was not known, it had "... not been possible to make an assessment of the likely effect of cargo aggregation on ports."(Report of the New Zealand Ports Authority,1971,12).

At the time Government accepted in principle the proposal that a limited container service should be commenced between New Zealand and the United Kingdom, no study had examined the domestic, social and economic implications of such a service. Though the Government was aware that non-container ports would be detrimentally affected, it was impossible for them to balance this "cost" against the estimated transport savings offered by containerisation.

3.4. South Island Meat Diversion Scheme

Controversy similar to that which followed the announcement that a limited container service was to be commenced to the United Kingdom, had also been sparked off by previous shipping decisions. In October 1967 a joint statement was made by the New Zealand Meat Board and the Overseas Shipowners' Committee advising that all meat exports from South Island ports (except from Picton and Nelson) for discharge at London and Liverpool would be programmed for loading at the ports of Timaru and Bluff. Following this statement, and a deputation of protest from representatives of the Otago and Lyttelton Harbour Boards, the Transport Commission was requested to investigate the proposal's costs and benefits. They were specifically requested to investigate "... the consequential detrimental effects upon the ports of Lyttelton and Otago."(Transport Commission, 1968a,1). Their findings are worthy of consideration in that they represent the first attempt made in New Zealand to quantify the probable impacts resulting from changing the structure of a distribution system.

Benefits predicted to result from the introduction of the meat diversion scheme were savings in shipping costs, (resulting from the more efficient programming of ships), and marketing benefits accruing from greater regularity of deliveries. These benefits were valued at $555,000 per annum. Detrimental effects to the ports of Lyttelton and Otago, comprising the loss in harbour board revenue and the loss of watersiders' earnings, were estimated to be $333,000 per annum.(12) The impact of these reduced earnings on the respective local business communities was not evaluated. Their calculations led the Transport Commission to conclude that the inauguration of the meat diversion scheme was in the national interest, but, having regard to the intangible and variable factors affecting the scheme, recommended that it be reviewed after a six month trial period.

In accordance with this recommendation, the Transport Commission again investigated the diversion scheme as it had operated between January and June 1968. Although both the shipping companies concerned and the Meat Board claimed that the scheme had operated successfully, and had in fact achieved better results than anticipated, the Commission found that it was unable to specify in monetary terms the benefits from the scheme. They were nonetheless satisfied that substantial benefits had resulted. Losses to the Lyttelton and Otago Harbour Boards proved difficult to determine as both ports had suffered a considerable reduction in total tonnage, in addition to that lost due to meat diversion. Gross revenue received by both Boards declined, as did the number of registered

waterside workers employed at the ports. Following this second investigation the Commission again found that "... the continuation of the meat diversion scheme is in the national interest of New Zealand."(Transport Commission,1968b,18). (12)

Footnotes

(1) This figure excludes investments made in private wharf facilities, such as at Tarakohe.

(2) Although commonly referred to as the "Streamlining Report", the actual title is New Zealand Overseas Trade: Report on Shipping, Ports, Transport and Other Services.

(3) This Committee's findings, published as New Zealand Overseas Trade - Report by the Container and Cargo Handling Committee, are commonly known as the "Molyneux Report".

(4) The qualifications included the number and location of container ports, and the fact that no container operation was yet in operation over so great a distance as 13,000 miles.

(5) For example only the cellular container system was investigated, while pallets were assumed to be carried by conventional break-bulk ships. Modern unitised systems, such as side-door multi-purpose vessels, do not appear to have been evaluated.

(6) It should also be noted that Metra did not consider the substantial investment required in the internal transport system to handle this container traffic.

An example of information of dubious validity used by Metra in their calculations concerns the average wages per annum per man employed at container terminals. Their estimate was $3,000(Metra 1969,Vol.2,28), whereas the average income received by New Zealand's waterside workers in 1969 was $3,905 per annum. (Annual Report of the Waterfront Industry Commission for the Year Ended 31 December 1969,84,92).

(7) As laid down in the New Zealand Ports Authority Act (1968,7) capital expenditure in excess of $250,000 in the case of the Auckland and Wellington Harbour Boards, $150,000 in the case of the Northland, Tauranga, Taranaki, Gisborne, Napier, Nelson, Lyttelton, Timaru, Otago and Southland Harbour Boards, and $50,000 in the case of any other harbour board must first be approved by the Authority.

(8) As described in the Report of the New Zealand Ports Authority(1972,6), a number of harbour boards had been authorised by special empowering Acts, prior to the Authority being established, to undertake certain harbour works. Harbour boards are not required to obtain the Authority's approval for the expenditure

of loan moneys authorised by these special Acts. But as these loans have to be sanctioned by the Local Authorities Loans Board (and the Authority is the Loans Board's adviser), the Authority is still able to evaluate such expenditure.

(9) Timaru Harbour Board, Annual Report and Statement of Accounts, Year Ended 30 September 1970,5.

(10) See Report of the New Zealand Ports Authority, For the Year Ended 31 March 1972(11).

(11) ECNA - East Coast North America.

(12) The Transport Commission themselves did not calculate the detrimental implications of the meat diversion scheme on the Otago and Lyttelton Harbour Boards. Rather they discussed the consequences the Harbour Boards themselves predicted would occur.

CHAPTER IV

EFFECTS OF SHIPPING DEVELOPMENTS ON PORTS AND REGIONAL ECONOMIES

In the previous chapter it was noted that the regional economic and social implications of recent shipping proposals have been the subject of much concern. Although the Government was aware that some ports and their associated regions would be detrimentally affected, no examination was made of these implications when evaluating the shipping services available to carry New Zealand's overseas trade.

Following the Government's decision to approve of the container principle many organisations protested that non-container ports would suffer a loss in trade and hence revenue, and that this loss would have adverse effects on the local economy. Under the container system some ports will undoubtedly lose a portion of their existing trade, but before one can comment on the ramifications this loss may have on the local economy, it is necessary to understand the actual role played by a port in the functioning of its local economy. In particular the additional revenue brought into an area due to the existence of a port must be known.

While port impact studies on overseas ports are common, for example see the Port of Seattle Commission (1971) and Schenker (1967), no similar studies have investigated the impact of New Zealand's ports on their local economies. In this study the economic impact, in terms of income and

employment, of the ports at Picton, Nelson, Lyttelton, Timaru, Oamaru, Dunedin and Bluff is investigated.

4.1 Port Economic Impact

Schenker(1967,127) notes that while the precise quantitative measurement of the economic impact of a port is impossible, a number of different aspects can be examined. Savings in transport cost can give those industries located near a port an economic advantage. Transport savings may even occur on commodities which are not shipped through the port since other transport modes may reduce their freight rates because of potential competition from shipping.(1)

The existence of a port produces widespread ramifications within the local economy and a distinction needs to be made between port-dependent and port-related activities. Port-dependent activities would include those firms involved with the direct operation and maintenance of ports, commercial ship-building and repair, supplying shipping with provisions and equipment, and moving goods to and from ports. Port-related activities would include these industries where location was determined by the existence of the port, and all trade and service functions generated by port-dependent activities. While port-related organisations such as banks, freight forwarders, shipping agents, and insurance companies derive much of their business from administering and servicing movements through a port, their level of activities would not be greatly affected if goods were moved into and out of the region by road or rail transport. On the other hand, the level of business of firms engaged in port-

dependent activities would mirror any changes in the volume of cargo handled at the port.

To enable objective comparisons to be drawn, it is essential that the approach adopted to determine a port's economic impact be consistent. Only the impact generated through the activities of harbour boards and waterside workers is examined, as it was impossible to gain access to the revenue and expenditure accounts of other port-dependent activities.

Direct Income Generated - During the 1969/70 financial year revenue received by the group of South Island Harbour Boards listed above exceeded $7.5 million (see Table 3).[2] This income was received from shipping firms, shippers and consignees for the provision of the necessary plant and services to facilitate the transfer of cargo from ship to shore, and vice versa.

Table 3

HARBOUR BOARD INCOME

Year Ended 30 September 1970

HARBOUR BOARD	INCOME[1] (Dollars)
Marlborough	557,492
Nelson	561,588
Lyttelton	2,201,539
Timaru	997,159
Oamaru	64,076
Otago	1,716,998
Southland	1,409,180
TOTAL	7,508,032

(1) This includes income from shipping services and general works, but does not include transfers from revenue funds or loans.

SOURCE: Harbour Board Annual Reports and Statement of Accounts.

Payments made to waterside workers for stevedoring and wharfingering, together with guaranteed payments, are shown in Table 4. As the Waterfront Industry Commission, which adminsters payments to watersiders, altered the period covered by its financial year at the end of 1969, it was impossible to determine this income during the same period as used for harbour boards. To overcome this problem a forecast was made of estimated payments to watersiders during the year ended 30 December 1970. These forecasts are also given in Table 4.[3]

Income and revenue received by these two groups is spent on the purchase of goods and services from other sectors of the economy. To predict the impact a reduction in watersiders' income or harbour board revenue may have on local business communities, it is necessary to examine their expenditure patterns. As the Government does not collect any statistics on personal spending patterns it is impossible to trace the flow of waterside workers' expenditure. However those business groups which received income directly from harbour boards can be determined.

Method - To trace the flow of harbour board expenditure a record was taken of every payment made by each board during the 1970 financial year. At all ports except Lyttelton these details were abstracted from summary files listing all payments made during a particular month. These files generally gave the name of the firm or organisation to whom payment was made, the value of the payment, and a brief description of its nature, e.g. purchase of welding equipment, resealing of roads, chairman's honorarium, PAYE

Table 4

WAGES PAYABLE THROUGH WATERFRONT INDUSTRY COMMISSION, 1970

Dollars

PORT	SHIPPING COMPANY PAYMENTS	W.I.C.[1] FUND WAGE PAYMENTS			TOTAL PAYMENTS[2]	ESTIMATED PAYMENTS[3]
		Port Unions' Stevedoring Fund	National Administration Fund	Sundry Payments		
Picton	55,628	16,693	26,801	590	99,712	138,201
Nelson	253,223	212,903	61,099	5,958	533,183	569,345
Lyttelton	1,390,366	535,921	224,425	21,883	2,172,595	2,577,067
Timaru	405,641	168,042	139,030	10,680	723,393	1,018,868
Oamaru	29,135	5,882	34,523	436	69,976	100,073
Otago	583,472	225,350	235,084	8,682	1,052,588	1,325,432
Bluff	783,080	393,777	171,710	3,672	1,352,239	1,577,247
TOTAL	3,500,545	1,558,568	892,672	51,901	6,003,686	7,306,233

(1) Waterfront Industry Commission.
(2) Nine Months Ended 30 September 1970.
(3) Year Ended 31 December 1970.

SOURCE: Waterfront Industry Commission, Annual Report and Statement of Accounts For Nine Months Ended 30 September 1970, Government Printer, Wellington.

tax. It was possible to distinguish payments made from the Loans Account and these made from the Cash Account.

At Lyttelton this information was taken directly from ledger cards, with each card recording all payments made to a firm or organisation. The reason for the payment was also stated.

In this way all those firms which received direct income from harbour boards, as well as the amount of this income, were identified. By recording every firm's address, the proportion of harbour board expenditure which is directed out of its local economy was able to be calculated.

Table 5 summarises each harbour board's expenditure during 1969/70 under several broad groupings. The purpose of these groupings is to isolate those main sections of the business community which received business as a result of the presence of a port. Although the distinction between several groups is rather fine, the main recipients of the boards' revenue can be seen.(4) Wages and salaries are the most important single expenditure item at all ports (when capital expenditure is excluded), and repairs and maintenance also account for a large proportion of each port's expenditure. During the 1970 financial year several of the ports were heavily involved in major development programmes. For example, substantial capital expenditure was made by the Southland, Timaru, Lyttelton and Marlborough Harbour Boards.

Not all of the revenue shown in Table 5 is injected into a particular port's local economy. Some revenue

Table 5

DESCRIPTION OF HARBOUR BOARD EXPENDITURE, 1969/70

Dollars

EXPENDITURE ITEMS	HARBOUR BOARD							
	Marlborough	Nelson	Lyttelton	Timaru	Oamaru	Otago	Southland	TOTAL
Wages, Salaries	99,378	300,475	1,070,706	309,962	33,392	484,179	346,096	2,644,188
Travel	9,001	5,041	19,956	6,454	1,811	14,082	33,833	90,178
Administration	78,892	36,113	153,565	46,659	1,926	54,237	19,065	390,457
Equipment Hire	4,899	7,630	10,787	13,535	485	-	85,431	122,767
Repairs, Maintenance	30,975	110,673	290,454	102,521	2,627	112,620	151,921	801,791
Fuel, Freight	14,394	31,268	83,034	18,130	1,676	59,718	28,482	236,702
Government	40,113	59,058	244,972	64,475	664	116,840	93,888	620,010
Local Bodies	9,599	15,764	51,656	35,647	2,666	53,188	27,285	195,805
Sub-total	287,251	566,022	1,925,130	597,383	45,247	894,864	786,001	5,101,898
Capital Expenditure	244,716	150,545	301,442	380,254	-	63,634	1,103,488	2,244,079
TOTAL	531,967	716.567	2,226,572	977,637	45,247	958,498	1,889,489	7,345,977

SOURCE: Derived from Harbour Board Monthly Summary of Payments and Ledger Accounts.

passes to other regions. By tracing the location of all firms receiving payments from the harbour boards, it was possible to estimate the amount of a harbour board's revenue which was initially directed into its local economy (see Table 6). By comparing Table 6 with Table 5 an indication of the revenue passing directly out of the various local economies can be obtained. Several immediate leakages were obvious. For example a proportion of the Nelson Harbour Board's expenditure passes directly to Wellington-based insurance and advertising firms; Southland pays engineering firms in Auckland; Timaru pays firms in Lyttelton for dredge repairs.[5]

Direct Employment Generated - During the year ended 30 September 1970, 2,667 people were employed at these seven ports as waterside workers or harbour board employees (see Table 7). When the employment opportunities provided by stevedoring firms, shipping companies, customs and forwarding agents, marine engineers, storage contractors and other port-dependent activities are considered, the role of ports in providing employment is seen as being quite significant.

4.2 Generated Port Impact

Sectors of the business community which received direct benefits as a result of harbour board activities were identified in Table 6. But the total impact on the various regional economies is much greater than this direct impact.

When money is injected into an economic system the income of that system increases not just by the value of that injection

Table 6

HARBOUR BOARD EXPENDITURE REMAINING WITHIN LOCAL ECONOMIES, 1969/70

Dollars

EXPENDITURE ITEMS	HARBOUR BOARD							
	Marlborough	Nelson	Lyttelton	Timaru	Oamaru	Otago	Southland	TOTAL
Wages, Salaries	99,378	300,475	1,070,706	309,962	33,392	484,179	346,096	2,644,188
Travel	8,127	4,809	19,128	4,918	1,729	13,070	33,562	85,343
Administration	23,935	31,282	152,932	44,976	1,746	53,472	18,212	326,555
Equipment Hire	4,899	7,630	10,787	12,760	485	-	85,431	121,992
Repairs, Maintenance	20,066	100,642	289,678	63,036	2,627	111,142	148,829	736,020
Fuel, Freight	14,394	30,635	83,034	18,110	1,676	59,718	28,482	236,049
Government	-	-	-	-	-	-	-	-
Local Bodies	9,599	15,764	51,656	30,376	2,666	53,188	25,487	188,736
Sub-total	180,398	491,237	1,677,921	484,138	44,321	774,769	686,099	4,338,883
Capital Expenditure	164,035	31,605	301,442	210,300	-	63,634	1,103,488	1,874,504
TOTAL	344,433	522,842	1,979,363	694,438	44,321	838,403	1,789,587	6,213,387

SOURCE: Derived from Harbour Board Monthly Summary of Payments and Ledger Accounts.

Table 7

EMPLOYMENT AT SOUTH ISLAND PORTS

1969/70

PORT	WATERSIDE WORKERS	HARBOUR BOARD EMPLOYEES	TOTAL
Picton (1)	30	38	68
Nelson	101	123	224
Lyttelton	625	324	949
Timaru	231	75	306
Oamaru	44	16	60
Otago	383	178	561
Bluff	377	122	499
TOTAL	1,791	876	2,667

(1) Railway workers employed at the Cook Strait rail ferry terminal are not included.

SOURCE: Waterfront Industry Commission, Annual Report and Statement of Accounts, For the Nine Months Ended 30 September 1970; Local Authority Statistics, 1969/70. Department of Statistics, Wellington.

but by some multiple of it.[6] The economic concept of the "multiplier" can be used to estimate the amount of secondary income and employment generated by the injection of this initial (or direct) income. The concept is extremely valuable in that it enables government to predict the effects on regional economies of measures involving the injection or removal of money into or out of a region. Here it provides a means of quantitatively assessing the total income and employment generated by some aspects of port activities. In turn the concept enables the repercussions of a decline in port activities to be predicted.

Application of the multiplier technique is only valid when the injected income may be treated as exogeneous. Income from port activities can be so treated. Shippers living outside the port area clearly bring income into the area when they use the port facilities. Shippers located within the port region also bring money into the area in using the port. As Schenker(1967,136) has demonstrated, "... if the other party to the transaction pays the shipping costs through the port, the shipper will include them in the price he quotes to the other party. In either case the port revenues are primary income.".

Estimation of Impact - Although many impact models and techniques have been developed, the three most common approaches are:

(i) Economic base-type analyses;
(ii) Simple multiplier models; and
(iii) Regional input/output techniques.

Collecting the original data required to produce a detailed regional input/output study is an extremely expensive

operation, and for this reason this approach could not be used.(7)

Isard and Czamanski(1965) have shown that the aggregate multipliersderived from economic base models and input/output models are of the same order of magnitude for each of a number of regions. Their finding was supported by Billings (1969) who, although not suggesting that the economic base model could replace the input/output model, considered that they were capable of producing indentical aggregate results.(8)

Impact studies involving the calculation of income and employment multipliers are very common - Garnick(1970) notes that virtually hundreds of regional impact studies have been produced during the present decade - but the author was unable to find any studies made of New Zealand situations. A variation of the economic base model is used to derive employment multipliers for a number of South Island regions.

Economic Base Models - The economic base approach postulates that all economic activity in a region may be divided into two types: basic and non-basic. Basic activities produce goods and services for export to buyers located outside the region, whilst non-basic activities provide goods and services used in the region. As basic activities are considered "city building" activities, the inference is that an increase in basic activities will result in a growth of total economic activity and population.(9)

An extensive literature has grown around the economic base model and its many variants. Tiebout(1962) reviewed much of the relevant literature, and Isard and Czamanski(1965)

discussed some difficulties inherent in the approach and compared ratios derived in economic base studies.

In many applications the diversion into basic and non-basic categories is in terms of employment, the regional employment multiplier being given as the ratio between total and basic regional employment. Separating basic and non-basic employment is very difficult, and an approach suggested by Thompson(1959) to help overcome this problem is adopted here.

In order to estimate the percentage of employment in every industry classification which was sustained by receipts from a source external to the subject economy, Thompson (1969) devised a specialisation ratio whereby total employment in an industy could be divided into two components: (i) employment sustained by external receipts, and (ii) employment expected in that industry if it were self-sufficient relative to the benchmark economy. The specialisation ratio stated mathematically is:

$$\text{Specialisation ratio} = \frac{ns - \frac{nB + ns}{NB + Ns}(Ns)}{ns}$$

where Ns and NB refer to total employment in the subject and benchmark economies respectively, and ns and nB refer to industy employment in the subject and benchmark economies. Thompson then used the ratios to separate employment by industry into basic and non-basic categories.

This approach is used to calculate employment multipliers for a group of South Island regions, and is demonstrated

by reference to the Nelson region. From the employment figures given in Table 8 a set of specialisation ratios were calculated (see Table 9). A specialisation ratio of 0.46 (calculated for Forestry and Mining in 1962), indicates that 46 percent of this industry's total employment was sustained by external receipts, i.e. 155 people. The specialisation ratios, computed for each region's industrial groups (see Appendix I - XIII), were used to separate total employment into basic and non-basic employment. These estimates were then used to analyse changes in basic and non-basic employment for a nine-year period, 1962 - 1970.

The estimates of basic and non-basic employment over the period 1962-1970 are shown for the Nelson region in Table 10.

Table 10

ESTIMATED BASIC AND NON-BASIC EMPLOYMENT IN NELSON, 1962-70

YEAR	EMPLOYMENT	
	Basic	Non-Basic
1962	1,307	8,829
1963	1,384	9,061
1964	1,397	9,303
1965	1,457	9,709
1966	1,444	10,281
1967	1,347	10,457
1968	1,477	10,307
1969	1,518	10,465
1970	1,672	10,753

Relating Nelson's non-basic employment to its basic employment by simple linear regression produces a regression coefficient of 1.017. This means that for a given change in basic employment, non-basic employment changed by 1.017 times that amount - a multiplier coefficient of approximately 2.02. The correlation, r, was equal to 0.69, but the

Table 8

EMPLOYMENT BY INDUSTRIAL GROUPS: NELSON

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	339	384	363	361	388	424	536	534	565
Seasonal Manufacturing	447	474	514	483	525	642	582	606	587
Food, Drink, Tobacco	361	391	375	408	432	415	400	391	428
Textiles, Clothing Leather	59	70	77	81	76	69	53	63	87
Building Materials	872	878	921	940	969	930	934	982	928
Engineering, Metal	860	894	911	1,026	1,265	1,241	1,181	1,202	1,359
Miscellaneous Manufacturing	251	242	256	287	309	334	325	320	336
Power, Water, Sanitary Services	384	383	388	351	386	408	437	445	447
Building, Construction	1,116	1,164	1,162	1,288	1,295	1,195	1,190	1,132	1,177
Transport, Communication	1,003	1,014	1,042	1,069	1,102	1,103	1,102	1,124	1,197
Commerce, Wool and Grain Stores	1,903	1,949	1,977	2,035	2,032	2,042	2,017	2,068	2,056
Domestic and Personal Services	421	437	456	462	479	473	486	476	502
Administration, Professional	2,120	2,165	2,258	2,375	2,467	2,528	2,541	2,640	2,756
TOTAL	10,136	10,445	10,700	11,166	11,725	11,804	11,784	11,983	12,425

Table 9

SPECIALISATION RATIOS: NELSON

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.4602	0.5070	0.5152	0.4765	0.5052	0.5047	0.5877	0.6067	0.6513
Seasonal Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Food, Drink, Tobacco	0.2610	0.3350	0.3253	0.3554	0.3634	0.3349	0.3125	0.3274	0.3364
Textiles, Clothing Leather	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Building Materials	0.4564	0.4476	0.4484	0.4394	0.4355	0.4441	0.4336	0.4389	0.3890
Engineering, Metalq	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.4167	0.4099	0.4124	0.3533	0.3808	0.3824	0.4165	0.4337	0.4139
Building Construction	0.1792	0.1967	0.1695	0.2019	0.1799	0.1381	0.1765	0.1458	0.2106
Transport, Communication	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0386
Commerce, Wool and Grain Stores	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Domestic and Personal Services	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Administration, Professional	0.1420	0.1316	0.1426	0.1448	0.1188	0.1040	0.0952	0.1064	0.1179

relative amount of variation in the dependent variable which was explained by the estimating equation was less than 50 percent ($r^2 = 0.48$). The employment multipliers calculated for all regions are shown in Table 11.

Table 11

SUMMARY OF REGIONAL EMPLOYMENT MULTIPLIERS

REGION (1)	EMPLOYMENT MULTIPLIER	CORRELATION COEFFICIENT	r^2
Blenheim	2.01	0.738	0.551
Nelson	2.02	0.691	0.480
Christchurch	2.00	0.010	0.000
Timaru	2.00	0.856	0.733
Oamaru	2.02	0.460	0.212
Dunedin	2.02	0.062	0.003
Invercargill	2.00	0.876	0.767

(1) Regions correspond to employment districts.

As is evident by the very low r^2 values in Table 11, with only Invercargill having a value greater than 0.75, the regression equations derived do not significantly explain the variation in the dependent variable (non-basic employment). Hence regional multipliers based on the economic base model can not be viewed with any degree of certainty and an alternative method is examined.

Simple Econometric Multiplier Models - These models permit certain variables to be made endogeneous and other items of importance, such as imports and taxes may be introduced. A comprehensive analysis of the methodological problems involved in the multiplier theory and in its application to actual processes of income development was undertaken by Hegeland(1966), and other main contributions on the regional income multiplier have come from Archibald(1967), Steele(1969) and Greig(1971). A brief summary of the model's principles is given in Appendix A

If the revenue received by ports was passed on completely to other groups the multiplier would be infinite. But in reality the effect of an initial expenditure becomes progressively weakened because of leakages. This is because at each stage of spending a portion of the income is withdrawn from the regional spending stream. It is not automatically respent on goods and services within the economy under discussion.

These leakages result from money being saved, being spent on the purchase of goods and services from other areas, and being removed through taxation. Therefore the amount of money passed on from group to group will become progressively smaller. The multiplier describes the relationship between the initial injection and the total economic impact generated.

In an "open" economy, in which a portion of domestic demand is supplied from imports, and where neither labour, land nor plant are fully utilised, the income multiplier will be inversely related to the leakages out of the system. That is,

$$K = \frac{1}{1 - c(1-m)}$$

where K is the income multiplier, c the marginal propensity to consume, and m the proportion of total demand which is met by imports. This formula is used to derive the income and employment generated through the activities of South Island harbour boards and waterside workers.

Multiplier Calculation - Values representing the average propensity to consume are derived from the following national private income and outlay figures: private income $4,276

million, personal expenditure $2,829 million, net transfers $10 million, direct taxation $887 million, private savings $550 million (Monthly Abstract of Statistics, December 1971). From this an average propensity to consume of 66 percent is obtained.(10)

There are no statistics available in New Zealand to indicate the level of inter-regional monetary flows. Such data is necessary to estimate the amount of an area's income which is spent on the purchase of goods and services from outside that region. In lieu of this data an approach suggested by Archibald(1967) is used to calculate regional import coefficients.

In discussing the magnitude of the United Kingdom's regional level of imports, Archibald(1967,27) considered that given the marginal propensity to import for the country as a whole, each region's import coefficient was unlikely to be less than 0.4. Given that regions were quite large, he felt it implausible that they should import more than three-quarters of their consumer goods. This then set the range of import coefficents. Assuming that regional "home produced" output consumed in any region is in proportion to the population of the region relative to the whole country, regional import coefficients may be derived.(11)

In calculating import coefficients for the regions surrounding the South Island ports, the lower limit of the coefficient is set as 0.26 - the proportion of New Zealand's income which is spent on the import of goods and services.

An upper limit of 0.70 is arbitrarily chosen. The possible range of import coefficients is therefore between 0.26 and 0.70, and coefficients are calculated on the basis of two "benchmark" economies - the South Island and New Zealand as a whole.[12] In addition multipliers are derived for two values of c , the average propensity to consume - 0.66 and 0.87.[13]

These regional multipliers are shown in Table 12 and illustrate the probable limits within which the actual multipliers lie. For example Nelson's multiplier is estimated to be between 1.27 and 1.43 and Southland's between 1.29 and 1.50. The Canterbury region is seen as having the largest regional multiplier (1.73), while the smallest multiplier (1.27), exists within the Marlborough, Nelson and Oamaru regions. This is to be expected as the degree to which income circulates within a region depends primarily upon the size of the region's economic base. The more goods and services that have to be imported, the more will be the leakages of money out of the region and the lower will be the multiplier's value.

These multipliers enable estimates to be made of the maximum and minimum regional economic implications of any shipping proposal which may result in the revenue of some ports increasing at the expense of others.

Generated Income - Applying the relevant regional multipliers to the initial expenditure injected by South Island waterside workers and harbour boards during 1969/70, it is seen in Table 13 that these activities generate between

Table 12

REGIONAL INCOME MULTIPLIERS

REGION	MINIMUM IMPORT LEAKAGE c = .66	MINIMUM IMPORT LEAKAGE c = .87 (1)	MAXIMUM IMPORT LEAKAGE c = .66	MAXIMUM IMPORT LEAKAGE c = .87
Marlborough	1.29	1.39	1.27	1.37
Nelson	1.30	1.43	1.27	1.37
Canterbury	1.47	1.73	1.32	1.45
Timaru	1.30	1.43	1.29	1.39
Oamaru	1.29	1.39	1.27	1.37
Otago	1.36	1.52	1.29	1.41
Southland	1.34	1.50	1.29	1.39

(1) Average propensity to consume.

Table 13

INCOME GENERATED BY HARBOUR BOARD AND WATERSIDE WORKERS' EXPENDITURE, 1969/70

Dollars

REGION	INITIAL EXPENDITURE		GENERATED INCOME			
			Excluding Capital		Including Capital	
	Excluding Capital	Including Capital (1)	Maximum	Minimum	Maximum	Minimum
Marlborough	425,452	670,168	591,378	540,324	931,533	851,113
Nelson	1,135,367	1,285,912	1,623,575	1,441,916	1,838,854	1,633,108
Canterbury	4,502,197	4,803,639	7,788,801	5,942,900	8,310,295	6,340,803
Timaru	1,616,251	1,996,505	2,311,239	2,084,964	2,855,002	2,575,491
Oamaru	145,320	145,320	201,995	184,556	201,995	184,556
Otago	2,220,296	2,283,930	3,374,850	2,864,182	3,471,574	2,946,270
Southland	2,363,248	3,466,736	3,544,872	3,048,590	5,200,104	4,472,089
TOTAL	12,408,131	14,652,210	19,436,710	16,107,432	22,809,357	19,003,430

(1) This represents waterside workers' total income and harbour board expenditure on the provision of works and services plus capital expenditure on harbour improvements, etc.

$16 million and $19.5 million in revenue. The port of Lyttelton has the greatest absolute impact, generating at least $5,942,900 in revenue, and there is seen to be a substantial range in the amount of regional income generated by the respective ports.

When capital expenditure injected in the process of port expansion and development schemes is taken into account, total generated revenue rises to between $19 million and $22.8 million. Generated revenue within the Southland region increases from at least $3,048,590 to $4,472,089 - a 46 percent increase. Similar large relative increases occur within the Marlborough and Timaru regions, reflecting the capital development projects underway at the ports of Picton and Timaru.

Generated Employment - The impact of port activities is forcefully demonstrated when the employment implications of this generated revenue are considered. By dividing this generated revenue by the relevant average regional income, an estimate of the indirect employment generated by the port activities is obtained (see Table 14).

Direct employment at these ports was earlier shown as being 2,667 during 1969/70 (made up of waterside workers and harbour board employees). This generated revenue is now seen as providing employment opportunities for at least 7,786 people. Indirect employment varies from between 89 and 97 within Oamaru, to between 2,872 and 3,765 within the Canterbury region. The inclusion of port capital expenditure sees indirect employment increasing to at least

Table 14

EMPLOYMENT GENERATED BY HARBOUR BOARD AND WATERSIDE WORKERS' EXPENDITURE, 1969/70

REGION	AVERAGE INCOME (1) (Dollars)	GENERATED EMPLOYMENT			
		Excluding Capital		Including Capital	
		Maximum	Minimum	Maximum	Minimum
Marlborough	1,904	311	284	489	447
Nelson	2,069	785	697	889	789
Canterbury	2,069	3,765	2,872	4,017	3,065
Timaru	1,992	1,160	1,047	1,433	1,293
Oamaru	2,075	97	89	97	89
Otago	2,005	1,683	1,429	1,731	1,469
Southland	2,229	1,590	1,368	2,333	2,006
TOTAL		9,391	7,786	10,989	9,158

(1) Average regional income during 1966/67 - the most recent year for which data was available.

SOURCE: Incomes and Income Tax in 1966/67. Department of Statistics, Wellington. Generated employment calculated from generated income totals shown in Table 13.

9,158, and when the families supported by these employees are taken into account, an indication of the magnitude of the role these ports play in generating employment opportunities is obtained.

Discussion - Although these multipliers were used specifically to calculate the regional economic implications of shipping policies, they are also relevant when considering the broader topic of regional development.

A common feature of depressed regions is the general weakness of the multiplier effect generated in their economies. The presence of a low multiplier means that attempts to boost industry or employment will be a tedious process, as any injection of capital into the region will result in a large proportion of it immediately leaking out - often this purchasing power will be transferred to regions experiencing high levels of demand and tight labour markets.(14) While the absence of substantial indirect effects is an obstacle to efforts aimed at invigorating depressed regions, the multiplier will only be strengthened by the progressive introduction of industries which are linked by flows of goods and services.

The regional multipliers shown in Table 17 do indicate that the absolute impact of a particular investment proposal would vary markedly between the regions. However without a more detailed inter-industry study, conclusions cannot be made regarding the relative regional effects of such proposals. Similarly, to predict the relative importance of the individual role played by each South Island port in the

functioning of its local economy, an input/output study is required.

4.3 Harbour Board Revenue by Cargo Form

Chapter III demonstrated that many harbour boards fear that a decline in their level of trade may jeopardise their economic viability, as well as having serious repercussions on adjacent communities. The regional income multipliers previously derived enable the total economic impact of fluctuations in port expenditure to be estimated, but it is first necessary to understand how individual ports will be affected by trade aggregation or diversion proposals. The Transport Commission (1968a, 1968b) and numerous harbour boards have attempted to predict the ramifications of particular shipping systems on harbour board finances. Generally these exercises have only calculated the extent to which revenue obtained from wharfage may decline, and have not differentiated between different types of cargo.

Method - To determine the amount of revenue accruing to harbour boards from handling particular types of cargo, within various trades, a systematic stratified sample was taken from harbour board Shipping Registers of all shipping which arrived at South Island ports during the 1970 financial year. For each ship selected, a record was made of all payments received by the harbour board while that ship was in port - not only for items paid for by the ship, but also those payments met by the shipper or consignee. As a large range of goods and services are provided by a port, revenue is received from a large number of sources (see Table 15). Numerous accounts had to be searched to locate all payments made by

the selected ships to the harbour boards.[15]

Table 15

HARBOUR BOARD REVENUE SOURCES
RELATED TO PROVISION OF WORKS AND SERVICES

REVENUE SOURCES		
Vessels	Cargo	Sundry Items
Berthage	Wharfage	Storage
Pilotage	Harbour Improvement Rate	Water
Port Charges	Equipment Hire: Cranes, Tractors, Forklifts, Weighbridge, Tallow Pump Wheat Augers, Meat Loaders	Electricity
Launch Hire		Ship's Telephone
Fenders		Garbage Collection
Moorings		Cleaning Berth
		Bonus Payments
		Overtime Payments

Total cargo loaded or discharged by each ship was recorded and, by dividing total revenue received by this tonnage, the direct revenue accruing to each harbour board from particular trades and commodities was determined. Each harbour board's revenue receipts by trade and cargo form, are listed in Appendix XIV to Appendix XX. The average revenue generated by the visit of various types of ships is also shown. A summary of the revenue received by the seven South Island harbour boards from each ton of cargo passing through their ports is given in Table 16. Receipts from each of the major types of cargo handled are shown.

Discussion - As might be anticipated, the revenue harbour boards receive from handling one ton of general cargo is much greater than that from liquid or dry bulk cargoes. This is because bulk commodities are loaded and unloaded by mechanical or automated methods, whereas the manual handling of general (breakbulk) cargo incurs much higher stevedoring

Table 16

HARBOUR BOARD REVENUE DERIVED FROM HANDLING DIFFERENT CARGO FORMS

Year Ended 30 September 1970

HARBOUR BOARD	COASTAL TRADE			OVERSEAS TRADE			ROLL-ON/ROLL-OFF
	General	Dry Bulk	Liquid Bulk	General	Dry Bulk	Logs	
	(dollars per ton)						
Marlborough	0.645	-	-	1.445	-	0.952	0.374 (1)
Nelson	1.446	-	0.994	1.741	0.608	1.078	-
Lyttelton	1.591	0.685	1.102	2.493	1.362	-	n.o.
Timaru	2.070	0.751	0.975	4.424	0.760	-	-
Oamaru	1.102	0.606	-	-	-	-	-
Otago	2.030	1.669	1.468	2.704	1.320	1.105	1.112
Southland	1.595	1.479	0.947	4.042	0.887	-	-

(1) Cook Strait Ferries.

n.o. - not obtainable.

SOURCE: Harbour Board records: Shipping Manifests; Shipping Registers; Equipment Hire Receipts.

costs. Moreover cargo movement rates and ship turnround times are slow in comparison with those achieved by bulk commodities, and port charges are therefore correspondingly higher. (Berthage payments are assessed according to the length of time a ship spends in port). For example each ton of overseas general cargo moving through the port of Timaru generates $4.24 in harbour board revenue, whereas the corresponding revenue from dry and liquid bulk cargoes is $0.76 and $0.96 respectively. Similar patterns are evident at the other ports.

It is apparent that a decline in general cargo movements through a port will produce a much greater revenue loss than a similar decline in dry or liquid bulk movements. It is this general cargo trade which is increasingly being concentrated through a reduced number of ports.

Variations in the revenue received from certain types of cargo between the harbour boards is mainly due to the different level of charges applying at each port. While charges levied on the ship are quite uniform, the scale of cargo charges - for wharfage in particular - does vary between boards. The higher revenue receipts from overseas general cargo at Timaru and Bluff are due to the all-weather mechanical loader hire charges.

As most general cargo ships carried a variety of cargoes, it was difficult to isolate the revenue obtained from a particular commodity.[16] However revenue received by the Nelson Harbour Board from fruit exports could be isolated. In 1969/70 the revenue obtained from this trade was $1.745

per ton. These figures are significant in that they demonstrate the impact shipping improvements may have on total harbour board income. A new fruit shipping service from Nelson, provided by J. Lauritzen Lines, commenced in January 1971. This improved service enabled fruit loading rates, and hence ship turnround times, to be increased, but as port and cargo charges remained constant the revenue received per ton, and hence total harbour board income, decreased. Although in this case the reduction in income was matched by a similar reduction in costs, Devos(1971) has shown that the introduction of some new shipping techniques may cause a decline in a harbour board's net income. As harbour board charges often bear no relationship to their long or short run average or marginal costs, the economic viability of some projects, such as dredging to obtain deeper water, may be dependent upon substantial tonnages of cargo being diverted from other ports.

These revenue per ton coefficients provide an accurate means of assessing the impact on harbour board finances produced by trade fluctuations. In turn the broader regional implications of these fluctuations may be determined. The coefficients permit quantitative comparisons in an area dominated by qualitative statements.

Waterside Workers Income - Trade aggregation or diversion will also produce changes in the income received by waterside workers. Here again these changes will have ramifications on the local economy.

To determine the income waterside workers received from

handling different types of cargo, a study was made of the actual stevedoring costs incurred at the various ports. The Waterfront Industry Commission is responsible for the fixing of wharf handling charges at most South Island ports.(17) These charges are based on the actual costs incurred during preceeding periods, and the waterside labour costs incurred in handling certain cargoes were derived from working sheets containing these actual costs. By averaging the payments made to watersiders for unloading general import cargo, and loading meat and wool exports, an estimation of the income watersiders receive for handling one ton of overseas general cargo was obtained.(18)

4.4 Containerisation of East Coast North America Trade

The New Zealand Ports Authority concluded that the containerisation of New Zealand's East Coast North American trade would not "detrimentally affect" non-container ports to any major extent. They did not indicate the financial loss likely to be experienced by particular harbour boards.

The derivation of the harbour board revenue coefficients enables this loss to be calculated. By multiplying the trade which would have been handled through each port, (had the container service not been introduced), by the relevant revenue coefficients, each port's total revenue loss is calculated. Table 17 indicates that while most trade is expected to be diverted from Lyttelton, Bluff may suffer the greatest financial loss, since it receives more revenue from each ton of cargo. Should South Island cargo be shipped through Wellington, Marlborough would receive a substantial

Table 17

CONTAINERISATION OF EAST COAST NORTH AMERICA TRADE: IMPACT ON SOUTH ISLAND HARBOUR BOARDS AND REGIONAL ECONOMIES

HARBOUR BOARD	1972/73 TRADE ESTIMATES (1) (Tons)	HARBOUR BOARD REVENUE IMPACT (Dollars)	REGIONAL IMPACT (2) Maximum (Dollars)	REGIONAL IMPACT (2) Minimum (Dollars)
Marlborough	520	- 752	- 1,801	- 1,646
Marlborough (3)	-	+ 29,320	+ 154,740	+ 141,381
Nelson	1,977	- 3,442	- 7,947	- 7,057
Lyttelton	28,065	- 69,966	- 201,152	- 153,480
Timaru	7,270	- 32,162	- 56,595	- 50,054
Otago	17,755	- 48,010	- 124,792	- 105,909
Southland	22,811	- 92,202	- 173,546	- 149,249

(1) Supplied by the New Zealand Ports Authority.

(2) This takes into account the income lost by waterside workers, as well as the revenue lost by harbour boards.

(3) Assuming that all South Island cargo was railed to the container terminal at Port Wellington, the Marlborough Harbour Board would receive "additional" trade, and hence revenue, as would the surrounding district.

increase in both trade and revenue.

Combining the revenue coefficients with the payments received by watersiders, the regional economic implications of this shipping service can be predicted. The handling of this cargo at Bluff normally generated between $150,000 and $170,000 into Southland's economy.[19] This revenue would be lost with the containerisation of this trade. Similarly between $150,000 and $200,000 would be removed from Lyttelton's surrounding community, although Marlborough's local payrolls would be increased by approximately $150,000.

Actual Impact - The commencement of the ECNA container service towards the end of the study period afforded an opportunity to calculate the actual changes in both internal movement patterns and levels of harbour board revenue which resulted. Data was obtained on the first four container shipments through Port Chalmers. The internal origin of the exports and the destination of the imports were obtained from manifests held by the Otago Harbour Board, and an account was made of all payments received by this Board as a result of this service. Revenue received from port charges, cargo dues, hire of container handling equipment and plant maintenance was collected. Dividing total container cargo handled by total revenue received, a value of $3.828 - representing the revenue accruing to the Otago Harbour Board in handling one ton of container cargo - was derived. The effective gain to the Otago Harbour Board is shown in Table 18, along with the revenue loss experienced by other ports.

Table 18

CONTAINER MOVEMENTS THROUGH THE PORT OF OTAGO

Year Ended 31 December 1971

HARBOUR BOARD	TRADE DIVERTED THROUGH OTAGO (1) (tons)	HARBOUR BOARD REVENUE IMPACT (dollars)	REGIONAL IMPACT Maximum (dollars)	REGIONAL IMPACT Minimum (dollars)
Lyttelton	3,903	- 9,730	-16,832	-12,843
Timaru	1,157	- 5,118	- 7,318	- 6,602
Otago (2)	2,349	+ 8,991	+13,666	+11,598
Otago (3)	9,433	+36,111	+54,888	+46,583
Southland	2,024	- 8,181	-12,271	-10,553

(1) The cargo carried on the first four container vessels which called at Port Chalmers: Columbus New Zealand (26/6/71), Columbus Australia (19/9/71), Columbus New Zealand (9/11/71) and Columbus Australia (28/11/71).

(2) Cargo which might have been expected to move through Otago.

(3) Total container cargo.

SOURCE: Container movement data collected from Otago Harbour Board.
Calculations based on previous Tables.

The voyages of the first four container vessels attracted over 7,000 tons of cargo away from the ports of Lyttelton, Timaru and Bluff. Harbour board revenue lost at these ports ranged from $5,118 at Timaru to $9,730 at Lyttelton. The removal of this money from their local economies is estimated to have effectively reduced income generated by up to $7,000 and $16,000 respectively. Conversely the Otago Harbour Board increased its revenue by approximately $25,000, with subsequent advantages to its local economy.

Figure 4 illustrates the cargo diversion pattern which accompanied the introduction of this container service.[20] While similar volumes of export cargoes have been diverted from Lyttelton, Timaru and Bluff, the majority of container imports handled at Otago were destined for the Christchurch area.

4.5 Comparative Port Impact

Until specific proposals emerge for consideration, only general comments can be made concerning the degree to which the various ports may be affected by shipping trends.

In predicting the impact the introduction of containerisation may have on South Island ports, the cargo aggregation pattern and transport mode used in this aggregation, will be extremely important. Another important factor will be the degree to which a port's cargo is suitable for shipment in containers.

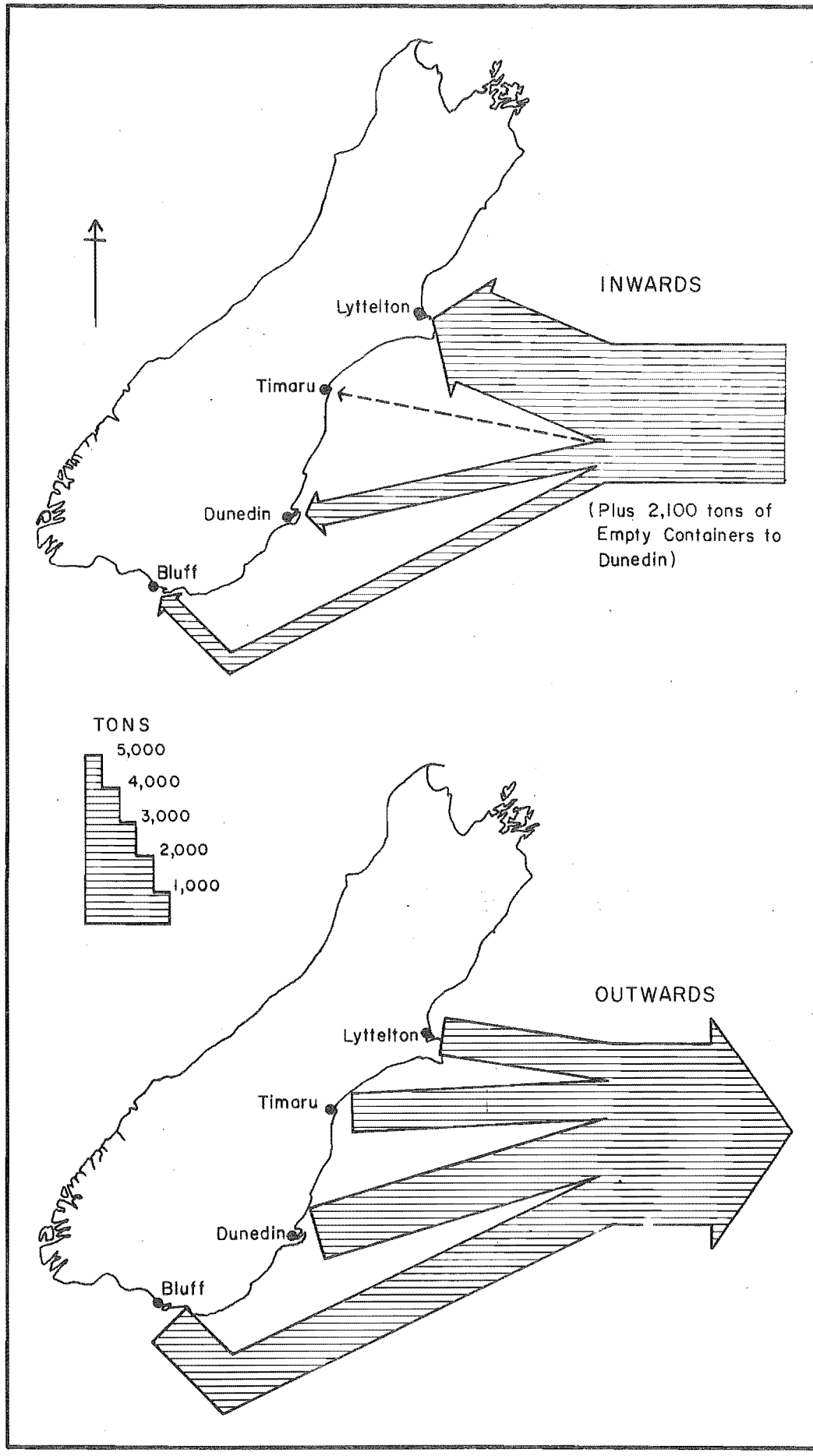


Figure 4 Container Shipments Through the Port of Otago: Origin of Exports and Destination of Imports, 1971

The proportion of the South Island's overseas trade which may be containerised is shown in Figure 5. It can be seen that at all ports except Lyttelton greater tonnages of exports than imports are suitable for movement in containers. Hence it would appear that even with the widespread introduction of containerisation many of these ports would continue to handle general cargo exports. Most of the exports shipped through Lyttelton, Timaru and Bluff during 1969/70 are suitable for container stowage, but the important log and timber trades through Nelson, Picton and Otago means that these ports do not stand to lose as great a proportion of their exports to container ports.

Imports will be less affected by the advent of containerisation, or other unitised cargo handling systems, as the majority of imports are bulk products such as manures and fertilisers. Many of these South Island ports are now handling rapidly developing bulk trades which, it has been argued, will effectively counter-balance any adverse effects resulting from containerisation. Trade generated by the new aluminium smelter at Tiwai Point may exceed 300,000 tons per annum, and Bluff may also be called upon to handle substantial forestry exports. The expansion of bulk grain shipments through Timaru will safeguard the future of this port, and timber and wood chip exports continue to increase through Nelson. Lyttelton is preparing to commence a new trade in wood chips. Nonetheless all these non-container ports must stand to suffer an absolute loss in revenue with the advent of

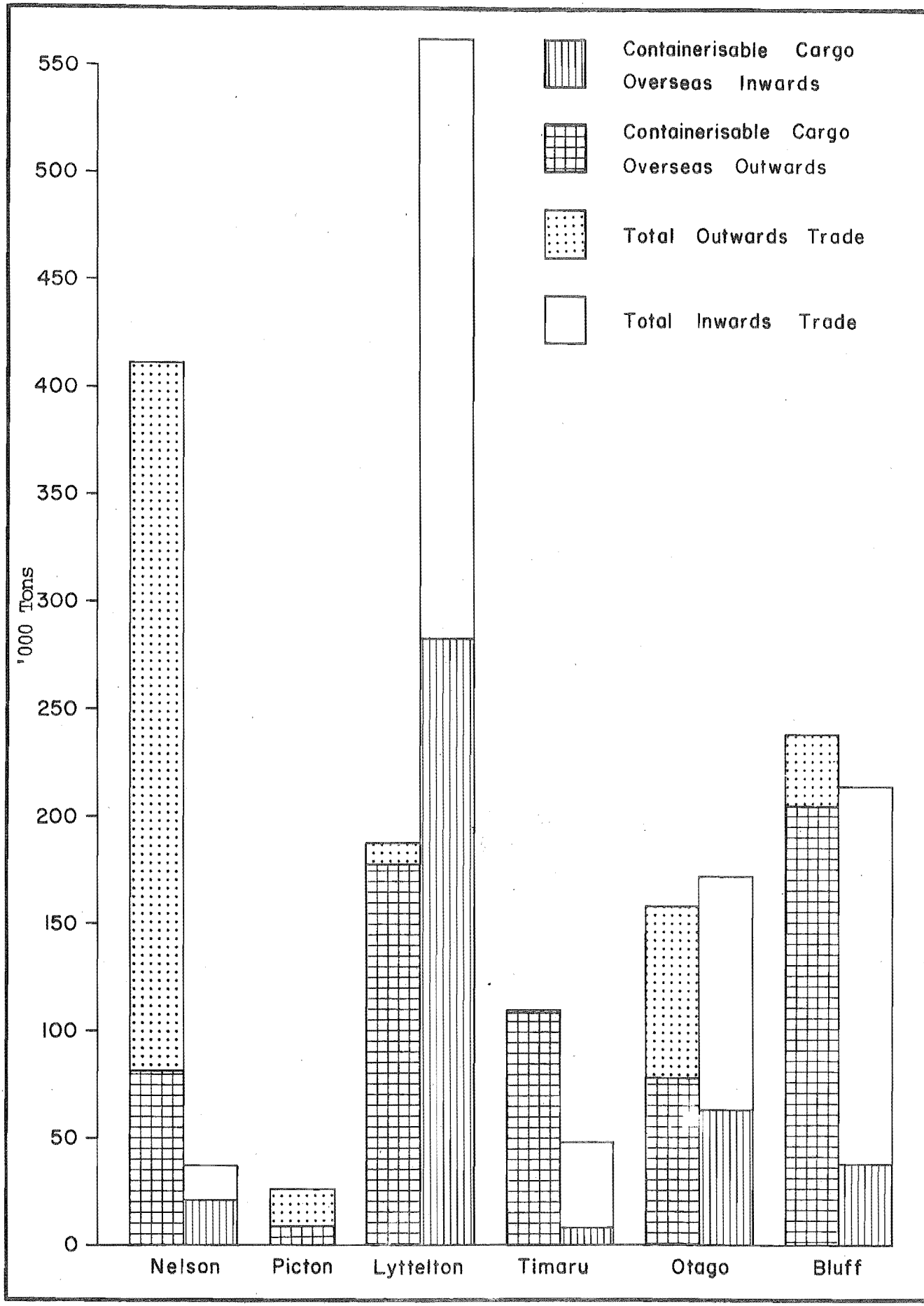


Figure 5 Overseas Cargo Suitable for Movement in Containers, 1969/70

containerisation.

The impact of this loss on each port will be influenced by the proportion of total revenue each port derives from its various activities. As some ports receive large sums of revenue from endowments, in the form of interest or rent, the relative impact may vary. Table 19 shows the various sources of harbour board receipts during 1969 and allows the relative importance of particular activities to be compared. Of the major export ports, Timaru and Bluff derive the greatest proportion of their total receipts from cargo handling activities, and may therefore stand to experience the greatest relative loss should trade decline.

However it can be seen that whereas Timaru and Bluff levy a land-based harbour improvement rate, unrelated to their trade levels, Lyttelton and Otago obtain their rates from a levy on cargo. Therefore a reduction in cargo levels at the latter two ports would produce not only a decline in their income from the provision of works and services, but also a decline in their total harbour improvements rates. However it is obvious that income from works and services provides most of the working capital of all the ports, varying from 43 percent of total receipts at Oamaru to 96 percent at Picton.

Even if general cargo is diverted away from certain ports, these ports must, at least in the short-run, continue to maintain and service their existing facilities. Thus in

Table 19

SOURCE OF HARBOUR BOARD RECEIPTS, 1969

Dollars[1]

HARBOUR BOARD	RATES		PROVISION OF WORKS AND SERVICES	RENT	INTEREST	TOTAL
	Harbour Improvement	Levied on Land				
Marlborough	-	-	534,639	14,302	4,330	553,271
	(-)	(-)	(96)	(3)	(1)	
Nelson	52,754	120,138	580,175	73,340	27,760	854,167
	(-)	(14)	(68)	(9)	(3)	
Lyttelton	343,891	-	1,876,926	131,664	254,225	2,606,706
	(13)	(-)	(72)	(5)	(10)	
Timaru	-	100,000	797,360	37,371	29,343	964,074
	(-)	(10)	(83)	(4)	(3)	
Oamaru	6,900	12,773	32,117	9,790	13,394	74,974
	(9)	(17)	(43)	(13)	(18)	
Otago	146,240	-	1,007,055	225,230	137,626	1,516,151
	(10)	(-)	(66)	(15)	(9)	
Southland	-	233,647	1,268,300	69,187	18,840	1,589,974
	(-)	(10)	(83)	(4)	(3)	

(1) Individual Items are expressed as percentages of the total. These percentages are shown in brackets.

SOURCE: Local Authority Statistics, 1969/70. Department of Statistics, Wellington.

the short-run it is realistic to consider most port costs as fixed, as these costs do not decrease with decreasing tonnage. Maintenance dredging, servicing of navigation aids and floating plant and maintenance of fixed structues must all continue if a port is to stay in operation. Hence in the short-run it seems inevitable that a decline in tonnage following the introduction of containerisation would necessitate port charges being increased.

In addition to these fixed (short run) operating costs, ports must also meet fixed capital charges. Annual loan repayments are shown in Table 20, and it can be seen that during 1969/70 these boards paid over $3,000,000 in loan interest and principal repayments. The outstanding debt at 30 September 1971 for these ports totalled $37,743,570. Any substantial decline in total trade may necessitate harbour board rates being increased.

Employment Implications - With one of the main aims of the containerisation concept being to reduce the labour content required to transport goods, the advent of this system is likely to reduce employment possibilities at these South Island ports. Although waterside workers are no longer employed on a casual basis and receive guaranteed payments when work is not available, the widespread introduction of containers will lead to redundancy.[21] The Royal Commission of Inquiry into containers considered that redundancy problems should be

Table 20

HARBOUR BOARD PUBLIC LOAN INDEBTEDNESS AND ANNUAL LOAN REPAYMENTS, 1969/70

Dollars

HARBOUR BOARD	REPAYMENTS MADE DURING YEAR (1)	AMOUNT OUTSTANDING (2)
Marlborough	81,681	1,252,571
Nelson	209,825	3,530,867
Lyttelton	1,266,195	10,677,239
Timaru	341,112	2,868,644
Oamaru	8,703	163,461
Otago	412,455	6,915,592
Southland	797,078	12,335,196

(1) Includes loan interest and principal repayments but does not include sinking fund payments.

(2) As at 30 September 1970.

SOURCE: Harbour Board Annual Reports and Statement of Accounts.

treated as a matter of urgency, and they recommended that the Labour Department should initiate and encourage retraining programmes for displaced wharf workers.(22)

The employment impact at each port will also be influenced by the transport mode used to aggregate containers. Should coastal shipping be used, the detrimental impact on both harbour board employees and waterside workers would be minimised. But current indications are that internal container aggregation will be performed exclusively by road and rail.

4.6 Possible Shipping Developments

The future role of many New Zealand ports will be largely determined by the type of shipping which emerges as best suited to meet the special requirements of the country's overseas trade. While it seems certain that general cargoes will increasingly be carried in a unitised form, the concentration of this trade through the two designated container ports, Auckland and Wellington, might not be as great as has previously been predicted. Some recent developments and proposals within particular trades are reviewed.

United Kingdom Trade - Following the British Conference Lines' decision in May 1971 to abandon their planned New Zealand/United Kingdom cellular container ship service, Associated Container Transportation, in conjunction with the Australian National Line, announced that they would modify their existing container service between Europe and Australia to include calls at Wellington and Auckland.

Initially four container ships will operate the service, to be commenced in September 1972, and late in 1973 a fifth ship, the 41,000 ton "Remuera" will join the fleet, increasing the frequency of sailings from every 17 to every 14 days. It is estimated that this service will handle only 20 percent of the New Zealand/United Kingdom trade, leaving the balance to be shipped by other means.

A supplementary refrigerated container service between Britain and South Island ports will be introduced early in 1973 by P. & O. (N.Z.) Ltd. Six of their conventional vessels now operating on this trade will be converted to handle a limited number of containers. Each ship will carry 26 containers on deck and will be equipped with its own travelling cranes and gantries to handle these containers. The service is designed primarily to be used in conjunction with the mechanical meat loaders at Timaru and Bluff.

At a time when the four main British shipping lines trading to New Zealand are removing their conventional vessels from the service, another company, Hudsons Freight Services Ltd., is exploring the prospects for introducing conventional shipping between Europe, Australia and New Zealand. This is another illustration of the uncertainty currently prevailing within the shipping industry. The company feels that there is a lack of conventional cargo space on this trade and that the Conference system is forcing shippers into containerisation, irrespective of whether their cargo is suitable. Their service is envisaged as

being complementary to the container services, catering for heavy or awkward cargoes.

East Coast North America Trade - All of New Zealand's East Coast North America trade is now carried by two container services operated by Columbus Line and Associated Container Transport Ltd. Farrell Lines Inc. plan to have a regular 15-day service to New Orleans, Charleston, Philadelphia, Norfolk and New York in operation by mid 1973. Each of their four container ships will be equipped with a 70-ton conventional boom aft and a 30 ton crane forward, which will enable heavy-lift cargo and containers to be handled where shore-based container facilities are unavailable.

West Coast North America Trade - The Columbus Line is considering introducing a full container ship service to the West Coast of the United States. Although final plans have not yet been decided, it is possible that three new vessels each carrying approximately 800 containers and maintaining a 24-day service might be introduced. Ports serviced in New Zealand would be Auckland, Wellington and Otago (Port Chalmers).

The Pacific Far East Line has announced that early in 1973 it will commence a LASH service between New Zealand (calling at Wellington and Auckland), and the west coast of North America. Preliminary indications are that two LASH ships would operate a 25-day service between the two areas. Each ship will carry 334 containers and 49 lighters as well as their own cranes, and are thus

virtually
~~completely~~ independent of shore equipment.

Scandinavian Trade - A new service anticipated to commence towards the end of 1972 should result in 95 percent of New Zealand's trade with Scandinavia becoming unitised or containerised. A consortium of shipping lines will replace the conventional freighters at present on the run with four multi-purpose part-container "Scandia" ships. Each ship will carry 200 containers with space for unitised loads, such as wool, and wet cargoes. Having their own handling equipment, the Scandia ships will also load conventional cargo and call at non-container ports, providing a more flexible service than full container ships. Ports of call will be Auckland, Lyttelton, Dunedin and Bluff, with occasional calls at Tauranga and Napier.

Japanese Trade - The P. & O. Group is planning to introduce a second modern unit-load ship on the Japan run early in 1973. A feature of these ships is that freight is loaded through two sideports. An outboard conveyor at each sideport is fed with special pallets by forklift trucks working on the wharf. The pallets are conveyed automatically to an elevator which is pre-set to deliver the goods to one of four decks where the ship's own forklifts take the cargo to stowing positions. Provision is also made to carry 56 containers on deck, and a 25-ton crane makes the ship independent of shore facilities.

4.7 Summary

In Chapter III some of the problems associated with technological change were outlined. With respect to the shipping industry one problem facing government is how it may weigh the benefits of a new system - which often can be quantified - against the wider socio-economic ramifications, which are often difficult to define let alone measure. While these ramifications are often recognised it is difficult to incorporate them in the overall decision-making process. Because of this, alternative transport proposals are often evaluated only by comparing their likely transport costs, the best system being that which offers the lowest costs.

Obviously the level of transport costs will be of critical importance in choosing between several alternatives. But they should not be the only factor taken into consideration. To help allow a wider viewpoint to be adopted, this chapter has demonstrated a method which permits some of these socio-economic effects to be measured. While only the detrimental spatial aspects associated with containerisation have been examined, the purpose was not to suggest that such technological advances not be introduced. Far from it. Many advantages will result from the adoption of this system, but in arriving at the decision to invest in a system having such widespread ramifications, both the advantages and disadvantages need to be closely examined. While many studies have highlighted the advantages, the disadvantages have frequently been glossed over as being relatively insignificant.

Footnotes

(1) Evidence was presented during the Commission of Inquiry into New Zealand Shipping (1971) which clearly demonstrated that this practice occurs within New Zealand.

(2) The 1969/70 financial year covers the period from 1 October 1969 to 30 September 1970.

(3) These forecasts were based on the annual payments made to Watersiders at each of the ports during the preceeding eight years. Equations representing the trend curves fitting this data were derived and used to predict 1970 payments.

It was not possible to merely factor the actual payments made during the nine months ended 30 September 1970, as monthly payments fluctuate in accordance with the seasonal nature of cargo movements.

(4) Some of these groups need to be elaborated. Expenditure related to the maintenance of port facilities - the purchase of tools, paint and repairs to mechanical equipment - are included in "Repairs, Maintenance", and those activities financed out of loan revenue appear under the "Capital Expenditure" category. "Travel" includes payments for staff and board members' travel and car mileage allowances, as well as accommodation and other expenses incurred while on business trips. Entertainment expenses such as catering, floral decorations and hall hire are included in this group. "Administration" covers payments made for all office equipment and supplies, as well as professional fees, journal subscriptions, donations to charity and authorised grants. Taxation and postal charges are the main payments under "Government" and payments to "Local Bodies" includes electricity, water, and other local body rates. Those payments made to other harbour boards for slipway hire, dredge hire etc., are included within this group. The remaining groups are self explanatory.

(5) A substantial proportion of harbour board expenditure goes towards meeting annual loan interest on principal repayments. For example, during 1969/70 approximately 30 percent of both the Southland and Otago Harbour Boards' annual expenditure went towards these loan requirements, and Lyttelton's loan payments accounted for 36 percent of its total annual expenditure. In view of these large amounts of income returned to the economy, an attempt was made to trace the flow of this money to determine the sum remaining in each port's local economy.

A number of harbour board loans were selected and the subscriber to each loan determined by searching the loan registers. But due to the nature of many of the organisations investing in these loans, it was impossible to achieve the required spatial breakdown. While private investors previously provided the majority of port loan finance, it is now increasingly common for commercial banks, insurance companies and, more recently the National Provident Fund, to be the dominant investors. Repayments to such organisations are generally made to their head offices, and it is difficult to predict the final destination of this money.

The Local Authority Loans Section of the Reserve Bank administers loan repayments for many harbour boards, but they were unable to provide any further details of the spatial distribution of these repayments.

To illustrate the subsciption pattern found, examples from two harbour boards' loans are given:

(i) Harbour Board "A": 49 percent contributed from Wellington area (78 percent of which came from insurance companies); 8 percent from other North Island areas; 38 percent from local investors; 5 percent from the remainder of the South Island.

(ii) Harbour Board "B": Shipping Company Provident Funds 13 percent; local bodies 27 percent, private local investors 25 percent; other South Island private investors 4 percent; insurance companies and savings banks 14 percent; trust organisations 5 percent; other organisations 12 percent.

(6) This can be illustrated by a simple example. Assume a shipping company pays watersiders $1,000 for discharging cargo from a ship: The Watersiders will spend some of this income on purchasing food or clothing, thus increasing the revenue received by people in these trades. They in turn will spend this money on purchasing other goods and services, thereby increasing the revenue received by other businesses. As the initial income moves round it generates further income. The income "multiplier" is a figure showing the relationship between total generated income and the initial injection.

(7) To overcome the high costs involved in performing input/output studies, several attempts have been made to apply adjusted national input/output coefficients to regional studies. As Garnick (1970,36) pointed out, "these have produced results which were for the most part, distinctly wanting for purposes of fine grained structural analysis.".

(8) Billings(1970) measured the impact of defence spending within Arizona using the input/output and economic base models. He found that the aggregate income multiplier from the input/output model was only 6.5 percent larger than the corresponding economic base multiplier. The employment multipliers were even closer together with the input/output multiplier exceeding the economic base multiplier by 47 percent.

(9) Conversely a decrease in basic activities will result in a decrease of total economic activity and population.

(10) Dividing private income by personal expenditure ($4,276 million/$2,829 million) equals 0.66.

(11) If the range of import coefficients was from 0.2 to 0.7, this would mean that the country as a whole would have an import coefficent of 0.2 and an extremely small region one of 0.7.

(12) For example, if a region in the South Island contained 11 percent of New Zealand's population its import coefficient would be 0.64 (i.e. 11 percent of the difference between 0.70 and 0.26). Should the same region have 39 percent of the South Island's population its import coefficient, when the South Island was the benchmark economy, would be 0.50.

(13) When taxation is regarded as a leakage, a c value of 0.66 is obtained. Assuming that taxation is returned to a region through Government spending, taxation is no longer a leakage in which case c would be equal to 0.87.

(14) Attempts to stimulate the economy of an area having a low income multiplier are commonly likened to "trying to fill a bath with the plug out".

(15) Ship charges including payments for berthage, port charges, pilotage, towage etc., were generally taken from harbour board Shipping Registers. Cargo dues were collected from original cargo manifests, or manifest summaries. The method used to determine payments made for equipment hire and other miscellaneous services such as berth cleaning, garbage removal and storage, varied from port to port. Frequently this information could only be obtained from original dockets or hire sheets.

(16) Harbour board revenue receipts from some particular commodities were obtained. For example, revenue generated at Nelson from the export of wood chips was $0.58 per ton, and wheat shipments through Timaru generated $0.75 per ton.

(17) Wharf handling charges are the charges made to the shippers or consignees of goods shipped through New Zealand ports, or to the owners of ships carrying the same, to cover the cost of handling the goods on the wharf.

(18) Nelson is the only port in New Zealand where the Harbour Board provides a complete wharfingering service. The Waterfront Industry Commission is not responsible for setting wharf handling charges at this port and so details on average payments made to waterside workers had to be obtained directly from the Nelson Harbour Board files.

(19) When the amount of revenue which the Southland Harbour Board stands to lose as a result of this one container service is realised, their comment that "... containerisation will have no effect on the harbour at Bluff for at least ten years...", may be premature (Southland Times, 20 May 1971). Even though the cargo lost will be more than compensated for with the opening of the aluminium smelter at Tiwai Point a relative loss will nonetheless be experienced. It is this general cargo which generates most income per ton to the Board, as well as providing greater employment opportunities.

(20) South Island ECNA cargoes were also diverted through the container port at Wellington.

(21) Here it is assumed that a similar proportion of each port's total overseas trade will be containerised, none of the ports will be a container port, and that coastal shipping will not be used to aggregate containers.

(22) Redundancy will also be a problem at the container ports of Auckland and Wellington. Industry sources believe that approximately 300 watersiders at Wellington and 400 at Auckland will become redundant as container services increase (Dominion, 2 October, 1972).

CHAPTER V

EVALUATION OF CARGO AGGREGATION PROPOSALS

The ability to predict the effects that changes in the transportation system will have on particular sectors of the economy enables a comprehensive evaluation to be made of transport proposals. An essential task of such analysis is to predict the impact of these changes on total distribution costs.

New Zealand is gradually beginning to accumulate a detailed body of knowledge illustrating the distribution costs incurred in her overseas trade. A general study describing these costs was made in 1967 (Transport Department,1967), and since then the Ministry of Transport has issued several bulletins which investigate the movement costs of individual commodities in greater depth (Ministry of Transport,1970a, 1970b,1970c). These studies, while valuable in pointing out areas of inefficiency in the country's distribution system, have tended to be retrospective. Local research in this field, while describing what has and is occurring, and suggesting ways by which the system might be improved, has not attempted to predict the changes in transport costs which might result.[1]

Several recent proposals aimed at lowering New Zealand's overseas freight bill, or at least reducing its rate of annual increase, have involved the concentration of cargo through a limited number of ports. Examples include the diversion of South Island meat bound for the United Kingdom through Timaru and Bluff; the channelling of fruit shipments through Nelson

and Napier; the Conference Lines' two-port container proposal; the suggestion that wool exports be handled at only two ports in both the North and South Islands; and the recent decision to concentrate the shipment of meat through Napier.

Following a brief review of overseas cargo movements at South Island ports during the period 1960 to 1970, a technique is demonstrated which permits transport proposals to be evaluated in terms of:

(i) their effect on total movement costs and;

(ii) their system-wide repercussions.[2]

5.1 Overseas Cargo Trends at South Island Ports

The magnitude and composition of imports handled at South Island ports during the period 1960 to 1970 is summarised in Figure 6. Several common trends are evident. Following the establishment of the Marsden Point oil refinery in 1964 there was a sharp reduction in the number of overseas tankers calling at South Island ports. With the increased distribution of oil and motor spirit products by coastal tanker, there was a corresponding decline in the level of total overseas imports. This loss has been somewhat compensated by the substantial increase in fertiliser imports through some ports, though this trade has fluctuated in accordance with farming demands. Several other factors have affected individual ports. The establishment of a motor assembly plant at Annesbrook led to an increase in the import of motor vehicle parts through Nelson, while trade at Timaru received a boost as a result of the Benmore hydro-electric scheme. Increased industrial activity within the Southland province led to a rise in the level of Bluff's imports, though an upsurge in fertiliser consumption

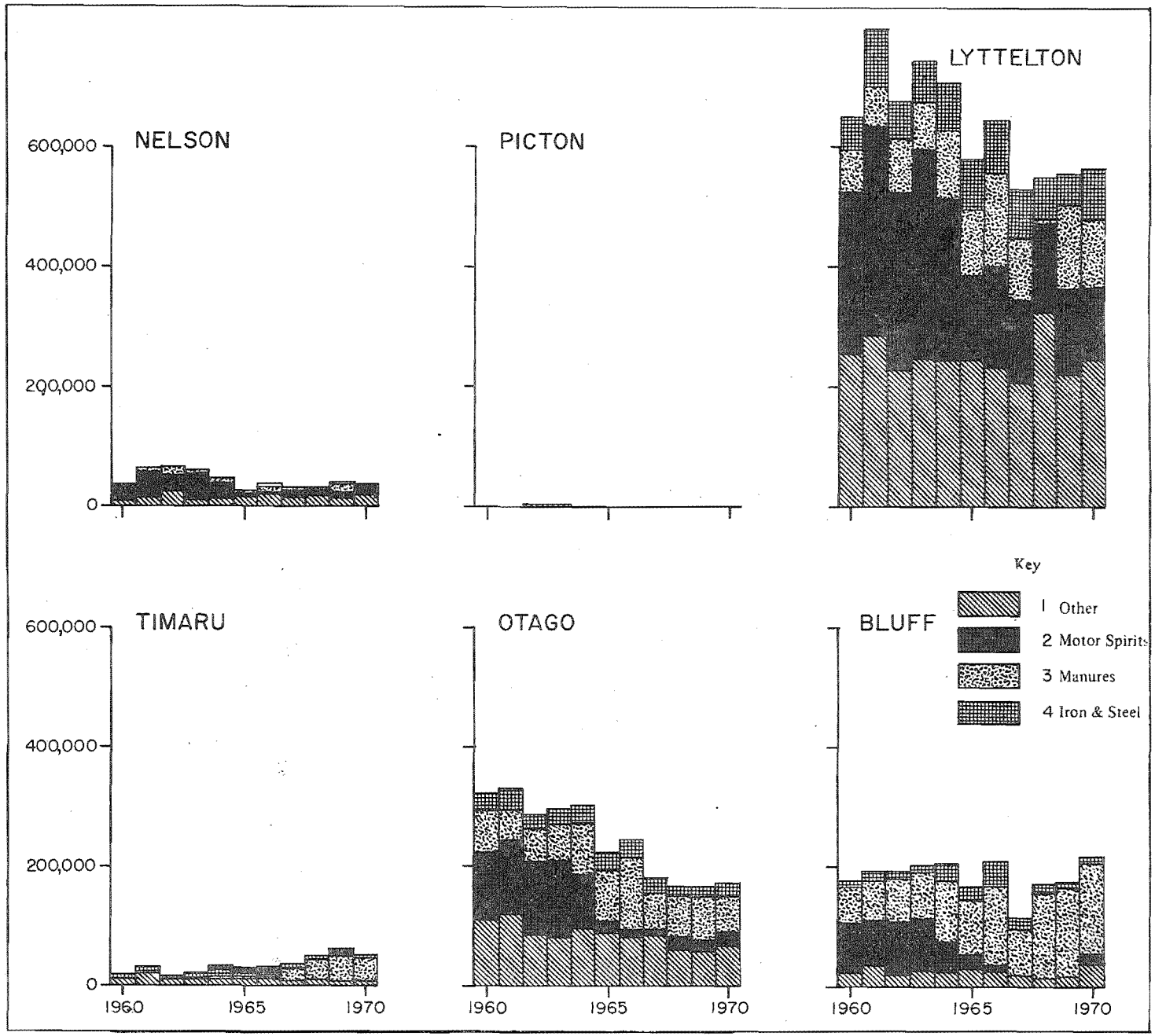


Figure 6 Cargo Trends: Overseas Inwards, 1960/70

has been the dominant factor accounting for this increase. Throughout the period Lyttelton has remained the Island's major import port and the decline in trade at Otago has reflected the changing distribution pattern of oil and petroleum products.(3) The bulk of Timaru's recent imports have been fertilisers and manures.

Greater changes have been evident in the pattern of exports (see Figure 7). Nelson's export trade has grown steadily, reflecting both the increased fruit production within the province and the much greater proportion of this fruit being loaded direct into overseas vessels. Over 30 percent of the total fruit movement through Port Nelson in 1963 was transhipped to Wellington. Harbour developments, allowing vessels to load more deeply, and the construction of cool stores adjacent to the wharves, resulted in this percentage dropping to less than 1 percent by 1970. The commencement of the timber trade with Japan, initially in logs and more recently in wood chips, led to a sudden upsurge in total exports, and this trend is expected to continue - although this pattern would be altered should a pulp mill be established within the district. The opening of a cool store at Spring Creek enabled fruit exports through Picton to greatly increase - this trade more than doubled in 1964. Since then shipments have declined as more of Nelson's fruit passes through its own port, although changes have occurred as a result of seasonal fluctuations. The resumption in 1969 of the log trade with Japan saw a marked upsurge in Picton's exports, and the recent granting of timber cutting rights should ensure this trade continues for a number of years. Lyttelton's export trade

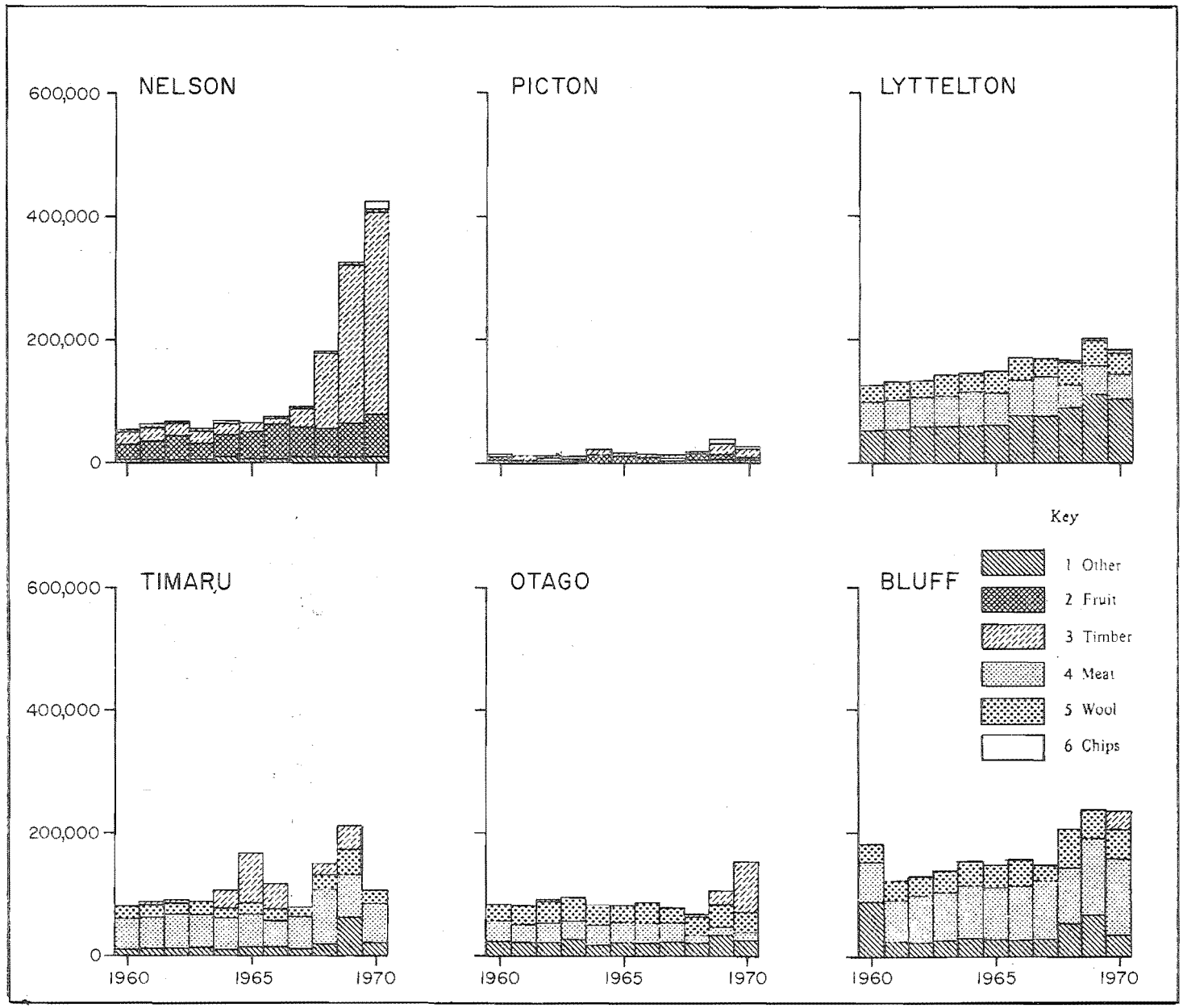


Figure 7 Cargo Trends: Overseas Outwards, 1960/70

has increased steadily throughout this period despite the diversion of a portion of its meat trade through the port of Timaru. This diversion meant a 40 percent decrease in meat exports in 1968 as compared with the previous year. Wool exports have remained stable but increases have been recorded in shipments of other agricultural commodities - peas and beans, hides and skins and tallow. With the installation of mechanical meat loaders, Timaru's exports have grown substantially, assisted for a period by the export of logs. Wool exports have reflected seasonal conditions and the export of grain in 1969 led to a sudden rise in that year's trade level. Drought conditions, together with the unavailability of grain for export, caused a sharp decline in Timaru's 1970 exports. The meat diversion scheme similarly affected Otago's level of exports, although the commencement of log shipments in 1969 led to a substantial rise in total trade. Additional meat shipments through Bluff followed the installation of its meat loaders, though increased production within the Southland province also contributed towards this rise. Grain shipments in 1968 and 1969 helped boost overall trade, as did the export of sawn timber and sawn logs to Japan, and native and exotic timber to Japan in 1970.

In summary, the diversion of meat through Timaru and Bluff and the exploitation of timber resources have been the two main factors influencing export totals at the various ports during this period. While increases in agricultural products in general have been recorded, trade in particular commodities has been subject to seasonal fluctuations.

5.2 Network Flow Analysis

In view of the necessity to reduce the time ships spend on the New Zealand coast, there will be continued pressure to concentrate the shipment of certain commodities at a restricted number of ports. Evidence of this trend is provided by the South Island meat diversion scheme, the similar concentration of meat shipments through Napier, and the suggestion that wool exports be handled at only two ports in the North and South Islands.

A very important factor in choosing the ports through which cargoes may be concentrated, are the internal transport costs incurred in the moving of cargoes to and from such ports. To determine the port combinations which will minimise these inland transport costs, under a variety of situations, a model is required. The nature of the problem is such that a model capable of evaluating the implications of a number of policy decisions, such as varying the number of ports through which shipping is to be permitted, is required. In addition, the model has to be capable of assessing whether the various port combinations have the physical capacity to handle increased cargo movements.

The model chosen is a form of network analysis based on the out-of-kilter algorithm developed by Ford and Fulkerson (1962). This algorithm solves the problem of determining the minimum cost route between two points in a capacitated network. It assumes that associated with each link are three values:

(1) A cost parameter representing the cost incurred in moving one unit of the commodity along the link.

(2) An upper capacity parameter indicating the maximum possible level of flow along the link.

(3) A lower capacity parameter, indicating the amount of the commodity which must move along the link.

The algorithm operated by defining conditions which must be satisfied by an optimal "circulation" in the network. When such an optimal circulation is determined, all arcs are "in-kilter". If such a circulation does not exist, some arcs will be out-of-kilter and the algorithm selects such an arc and tries to rearrange flows to bring it into kilter. More detailed descriptions of the algorithm are provided by Ford and Fulkerson(1962,162-169), Durbin and Kroenke(1967), and Gauthier(1968,105-108). An outline of the algorithm is given in Appendix B.

Sinclair(1969) and Sinclair and Kissling(1970) have demonstrated the algorithm's applicability in evaluating the impact of alternative fruit marketing programmes, and King et.al.(1971) used the algorithm to determine the optimal flows of coal in the Great Lakes area under a variety of supply and demand conditions.

Here the algorithm is used to derive the internal transport costs incurred in aggregated wool and meat exports at a variety of port combinations. The ability of the ports to handle this increased trade is also considered.

5.3 Evaluation of Alternative Wool Distribution Systems

In a review of the economic position of the farming industry in New Zealand, the Agricultural Production Council found that between 1960/61 and 1970/71 costs incurred in the marketing of wool (from farm gate to mill), increased by 31 percent while the price of wool fell from 33.6 to an estimated 23 cents per pound. In 1960/61 these costs amounted to

17 percent of the greasy-on-mill-floor price - the comparable figure in 1970/71 was 30 percent. Over half of these increased costs resulted from freight rises (Agricultural Production Council,1971,34).

The depressed nature of the wool industry has led to a number of its facets being closely examined and both the Wool Flow Advisory Committee(1968) and the Ministry of Transport (1970b) have investigated the wool distribution system. The Battelle Institute were commissioned by the Wool Board to study wool marketing and they found that distribution costs for New Zealand wool sold at auction formed approximately 23 percent of the total cost to overseas mills, and were equivalent to 37 percent of the farmers net proceeds for growing the wool(Battelle,1971,44).

Each of these studies outlined many of the problems contributing to the high cost of wool distribution. Some of these contributing factors were found to be:

(i) Handling problems and inefficiency in stowage resulting from small and variable lot sizes and weights;

(ii) Fragmented sources of wool supply, with many concerns all contributing wool for a single shipment;

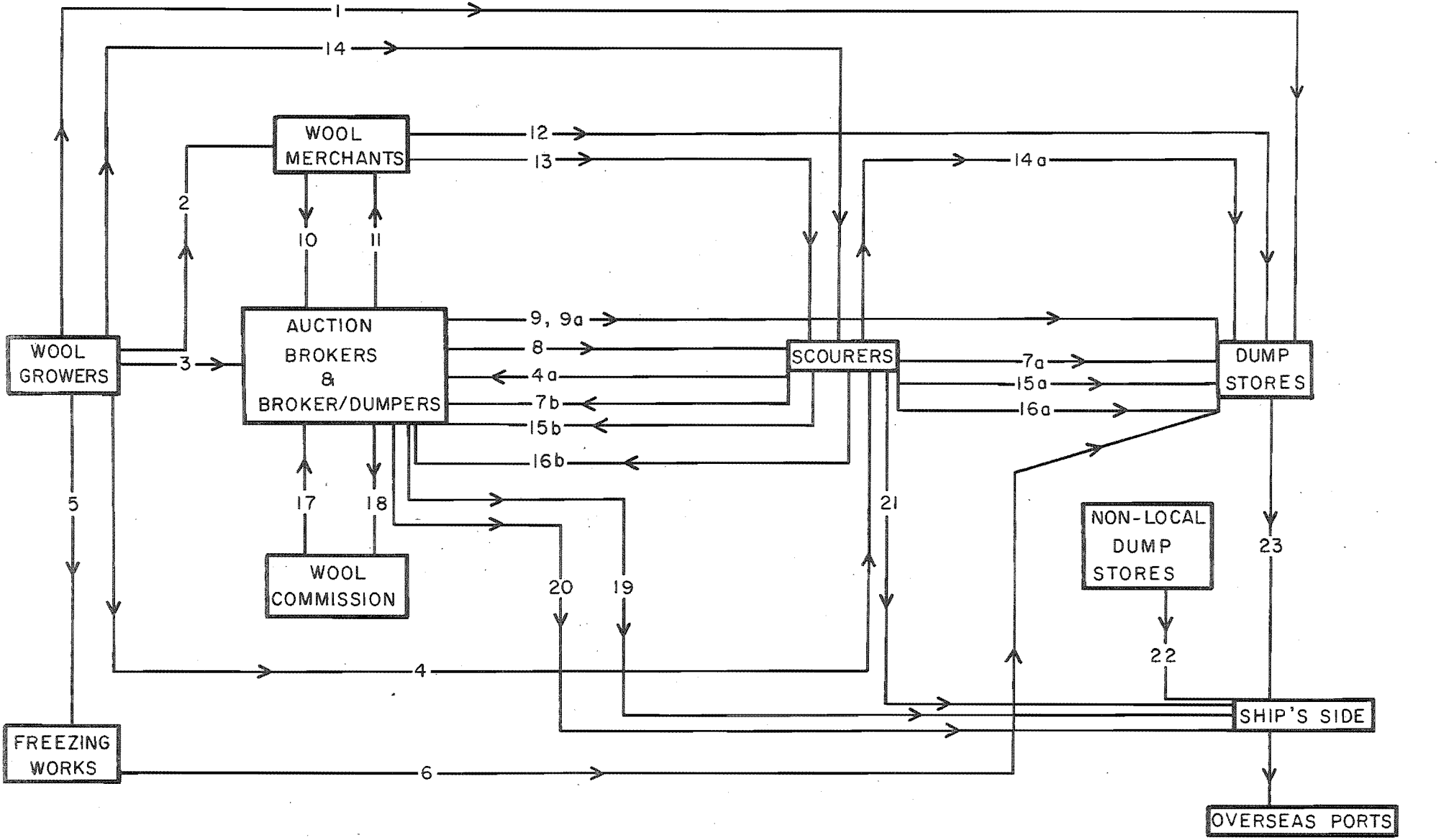
(iii) Lack of co-ordination between many sections of the industry;

(iv) Uncertainty regarding the amount of wool to be shipped and frequent changes in ship programmes;

(v) Inadequate load-out points from some dump stores which hinder despatch rates and in turn prevent ships from being efficiently loaded. Delays in moving wool to ports are often increased by traffic congestion;

(vi) Berth congestion and unsuitable vessels.

An illustration of the complex pattern of wool movement from grower to export port is provided in Figure 8. The many organisations involved in the distribution system, allied with



Source: Ministry of Transport(1970b,79)

Figure 8 Major Flow Patterns of New Zealand's Wool Exports, 1968/69

IDENTIFICATION OF FLOW NUMBERS IN FIGURE 8

Flow Number	Explanation
1	Grower's Wool (Greasy) Exported for London Auction
2	Purchases from Growers of Wool (Greasy) by Merchants
3	Grower's Wool (Greasy) - Sold at Auction by Brokers
4	Wool (Greasy) From Growers to Scourers Prior to Auction
4a	Wool (Scoured) From Scourers Prior to Auction
5	Wool (On Sheep's Back) to Freezing Works Prior to Killing
6	Wool (Slipe) From Freezing Works to Brokers and Dump Stores
7	Wool (Slipe) From Freezing Works to Scouring Works
7a	Wool (Scoured) From Scouring Works to Dump Store for Export
7b	Wool (Scoured) From Scouring Works to Broker/Dumpers for Export
8	Wool (Greasy) to Scourers After Auction
9	Wool (Greasy) to Dump Store After Auction
9a	Wool (Scoured) to Dump Store After Auction
10	Merchants' Sales of Wool at Auction
11	Merchants' Purchases of Wool at Auction
12	Merchants' Exports of Wool (Greasy) to Dump Stores
13	Merchants' Wool to Scouring Works Prior to Export
14	Grower's Wool to Scouring Works Prior to Export for London Auction
14a	Grower's Wool (Scoured) to Dump Store Exported for London Auction
15a	Post-Auction Wool (Scoured) to Dump Store for Export
15b	Post-Auction Wool (Scoured) to Broker/Dumpers for Export
16a	Merchants' Wool (Scoured) to Dump Store for Export
16b	Merchants' Wool (Scoured) to Broker/Dumpers for Export
17	Sales of Wool Commission Stockpile at Auction (Greasy & Scoured)
18	Purchases of Wool Commission Stockpile at Auction (Greasy & Scoured)
19	Wool Sent by Brokers Direct to Ship's Side (Greasy and Scoured)
20	Wool Sent by Broker/Dumpers Direct to Ship's Side (Greasy and Scoured)
21	Scouring Works Direct to Ship's Side
22	Non-Local Dump Stores to Ship's Side (Greasy, Scoured, Slipe)
23	Dump Stores to Ship's Side (Greasy, Scoured, Slipe)

the large range of marketing options available to the grower, means that control over this sector is difficult to achieve. A further hindrance to efficient movement is the frequent requirement that shipments be made as soon as possible after a wool sale.

The fragmented nature of the internal distribution system, combined with the other factors listed in the preceeding paragraph, often result in low levels of productivity on the waterfront. Table 21 indicates that despite the greater use being made of mechanical handling equipment, wool loading rates at New Zealand's ports have not risen appreciably between 1965 and 1970, although costs continue to increase.(4) These low loading rates in turn mean slow shipping turnaround. The inability of the distribution system to despatch sufficient quantities of wool to the ports, to allow faster loading, is the major reason for this low productivity.

Table 21

WOOL LOADING RATES AT SELECTED NEW ZEALAND PORTS, 1965/1970

Bales per Gross Gang Hour

YEAR	PORT					NEW ZEALAND
	Lyttelton	Timaru	Dunedin	Port Chalmers	Bluff	
1965	50	59	49	43	52	45
1966	48	62	46	47	51	45
1967	48	63	46	41	52	46
1968	50	60	56	41	58	49
1969	55	62	58	50	57	51
1970	53	63	51	49	61	49

SOURCE: Waterfront Industry Commission, Annual Reports and Statement of Accounts, 1966 to 1971. Government Printer, Wellington.

Each of the above studies suggested ways in which the wool distribution system might be improved, (for example through pre-assembly of wool at wharf sheds, the introduction of dense baling, larger lot sizes and increased use of unit loads), but it appears as though a major spatial re-organisation of the system is required. The New Zealand Wool Board feels that substantial freight savings could theoretically be achieved if ships were able to load a full cargo at only one or two ports, thereby reducing the number of days spent on the New Zealand coast. This could only be achieved by stockpiling wool at selected ports in large quantities, and this in turn may require a re-organisation in the present number of wool selling centres.

The Wool Board has suggested reducing the number of wool selling centres from eight to possibly four, with only two main wool loading ports in each Island. Though Battelle (1971,44-47) discussed this topic at some length, and made a conservative estimate of the cost benefits of a two auction centre/two port system, they stressed that their analysis was "... very simple and (their) cost figures used... merely rough estimates since no real analysis is possible without a thorough study of all factors involved.".

Using the network analysis technique outlined earlier, internal transport costs associated with various wool movement schemes are derived, and the system repercussions of these aggregation schemes calculated.

Wool Movement Data - Estimates of average wool production within each South Island county were obtained by multiplying

county sheep numbers by average wool production per sheep (see Appendix XXI and XXII). To prevent distortions occurring, due to drought and other seasonal conditions, sheep returns and wool production were averaged over a three year period. The results from these calculations are listed in Table 22. These production estimates represent the volume of wool which must be transported from country to selling centre and then to port of shipment.

The link costs entered into the model were road and rail wool transport charges (see Appendix XXIII), and average port handling costs, wharfage dues and harbour improvement rates (Appendix XXIV).[5] Data supplied by the New Zealand Wool Board indicated the distance travelled by the "average" bale within each county in moving from farm to county railhead, or farm to selling centre. Transport rates were based on these distances. Dumping, scouring and selling charges were not included.

As indicated by Figure 8, wool may pass through an extremely complex distribution system before being shipped overseas. Wool movements were generated from all South Island counties to wool selling centres, and from these centres to export ports, under a variety of distribution policies. For example, the effects of limiting the number of export ports, or reducing the number of selling centres, or varying wool handling costs were evaluated.[6] The wool network contained 202 links and 60 nodes and 184 different distribution systems were generated.

Table 22

ESTIMATES OF AVERAGE WOOL PRODUCTION
WITHIN SOUTH ISLAND COUNTIES

1967/1970

COUNTY	BALES	COUNTY	BALES
Marlborough	25,715	Akaroa	5,177
Awatere	11,874	Wairewa	3,520
Kaikoura	8,593	Ellesmere	14,631
		Ashburton	84,962
Waimea	18,781	Geraldine	22,725
Golden Bay	3,196	Levels	14,729
Buller	558	MacKenzie	26,076
Inangahua	2,311	Waimate	38,117
Westland	6,962		
		Waitaki	34,620
Amuri	18,908	Waihemo	8,789
Cheviot	11,083	Waikouaiti	6,739
Waipara	24,141	Peninsula	1,562
Ashley	11,579	Taieri	16,981
Rangiora	3,71	Bruce	25,595
Gyre	5,328	Clutha	51,335
Oxford	7,988	Tuapeka	39,337
Malvern	26,844	Maniototo	2,283
Paparua	5,333	Lake	13,659
Waimairi	161	Vincent	24,484
Heathcote	367		
Mt. Herbert	1,889	Southland	217,729
		Wallace	91,733

SOURCE: Calculated from data contained in - Sheep Returns, 1968, 1969 1970, Department of Statistics; Annual Review of the Sheep Industry 1968/69, 1969/70, 1970/71, New Zealand Meat and Wool Boards' Economic Service.

Discussion of Results - Table 23 illustrates the transport costs incurred in moving wool from South Island counties to selling centres, and then to ports. Should shipping economics favour only one port of call in the South Island, the channelling of wool through Otago would result in internal transport costs being minimised (assuming that wool from the north of the South Island could be shipped through Wellington). While this ranking is the same as that computed by the Otago Harbour Board (1971,20) the absolute differences between the ports selected are not the same. Otago's calculations indicated that the cost of aggregating wool exports at Timaru was six percent greater than through their own port, while Table 23 shows this difference as only being three percent.

Inland transport costs are reduced when wool is aggregated at two South Island ports. Timaru/Bluff is the port combination minimising these costs, being more than $65,000 less than the next best port combination, Lyttelton/Bluff. This ranking is not altered with the inclusion of Wellington (see Table 23).

More realistic estimates of the costs of alternative distribution systems are obtained when wool handling costs at the various ports are entered into the analysis. Allowing wool to be exported through all South Island ports was found to cost $3,084,271, with the respective port hinterland's outlined in Figure 9. When shipments through Picton and Nelson are prohibited total costs increase to $3,234,994 (see Table 24), and Lyttelton's hinterland is increased through the addition of Awatere and Kaikoura counties (see Figure 10).

Table 23

TRANSPORT COSTS INCURRED IN MOVING WOOL
FROM COUNTY TO PORT

1967/1970 Production Estimates

PORT COMBINATIONS	CARGO (Bales)	COST (Dollars)
One South Island Port		
Wellington	59,566	
Lyttelton	880,544	3,619,681
Wellington	98,150	
Timaru	841,960	3,124,722
Wellington	125,160	
Otago	814,950	3,034,778
Wellington	143,701	
Bluff	796,409	3,270,028
All Ports		
Wellington	59,566	
Lyttelton	244,051	
Timaru	136,267	
Otago	190,764	
Bluff	309,462	1,976,662

PORT COMBINATIONS	CARGO (Bales)	COST (Dollars)
Two South Island Ports		
Lyttelton	405,264	
Otago	534,846	2,592,789
Lyttelton	439,884	
Bluff	500,226	2,404,974
Timaru	439,884	
Otago	500,226	2,584,752
Timaru	514,381	
Bluff	425,729	2,339,188
Wellington	59,566	
Lyttelton	345,698	
Otago	534,846	2,584,304
Wellington	59,566	
Lyttelton	380,318	
Bluff	500,226	2,396,489
Wellington	98,150	
Timaru	341,734	
Otago	500,226	2,567,009
Wellington	98,150	
Timaru	416,231	
Bluff	425,729	2,321,445

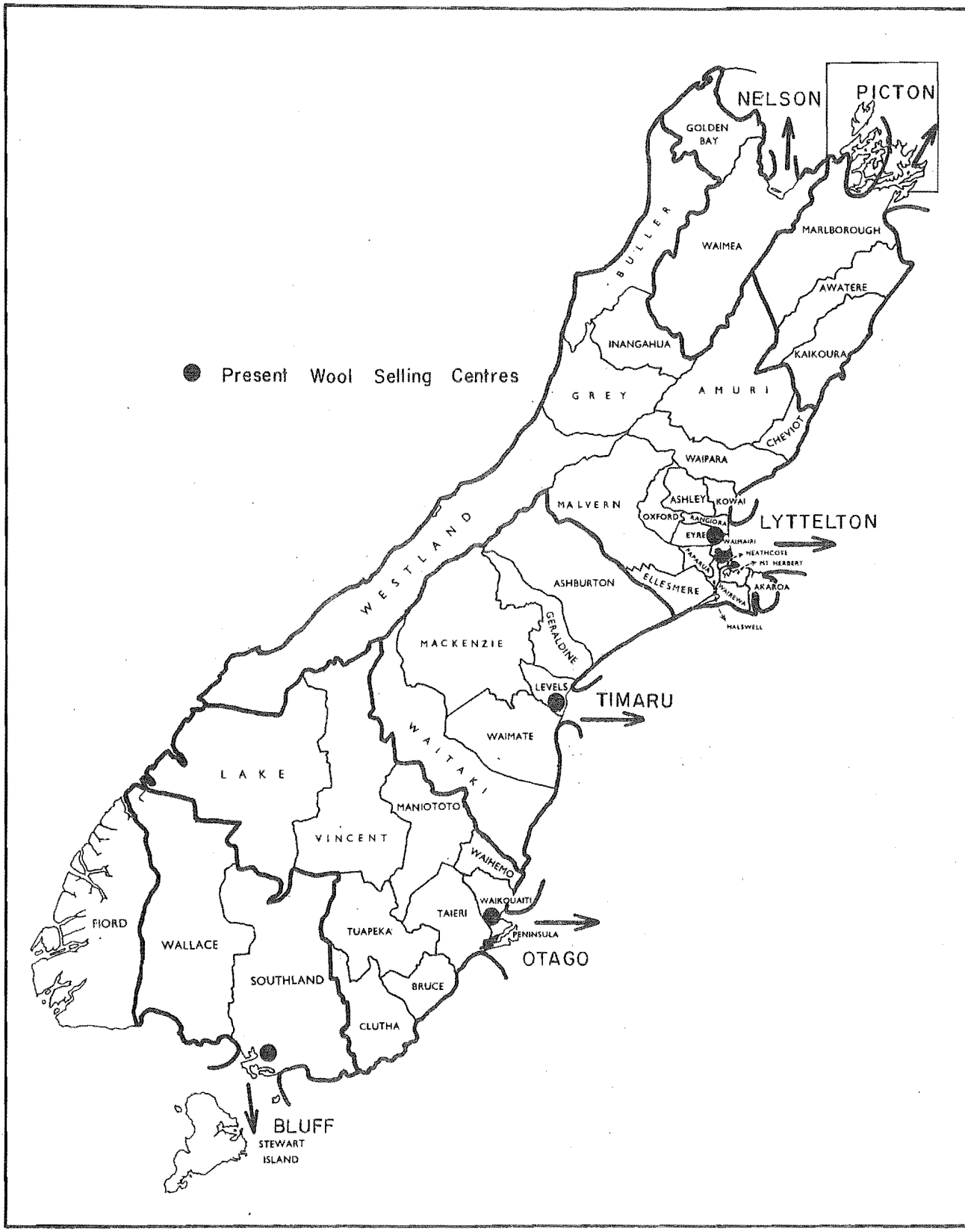


Figure 9 Simulated Wool Movements: Shipping Possible Through all South Island Ports

Table 24

TRANSPORT COSTS INCURRED IN MOVING WOOL FROM COUNTY TO SHIP

1967/1970 Production Estimates

PORT COMBINATIONS	CARGO (Bales)	COST (Dollars)
One South Island Port		
Lyttelton	940,110	5,000,727
Timaru	940,110	4,351,992
Otago	940,110	4,361,073
Bluff	940,110	4,875,138
Wellington	47,692	
Lyttelton	892,418	4,988,898
Wellington	59,566	
Timaru	880,544	4,321,523
Wellington	98,150	
Otago	841,960	4,267,513
Wellington	125,160	
Bluff	814,950	4,670,495
All Ports		
Wellington	47,692	
Lyttelton	170,963	
Timaru	221,229	
Otago	190,764	
Bluff	309,462	3,234,994

PORT COMBINATIONS	CARGO (Bales)	COST (Dollars)
Two South Island Ports		
Lyttelton	405,264	
Otago	534,846	3,885,123
Lyttelton	439,884	
Bluff	500,226	3,802,546
Timaru	439,884	
Otago	500,226	3,814,288
Timaru	553,718	
Bluff	386,392	3,646,563
Wellington	47,692	
Lyttelton	392,192	
Otago	500,226	3,878,612
Wellington	47,692	
Lyttelton	392,192	
Bluff	500,226	3,790,717
Wellington	59,566	
Timaru	380,318	
Otago	500,226	3,783,819
Wellington	59,566	
Timaru	380,318	
Bluff	500,226	3,616,094

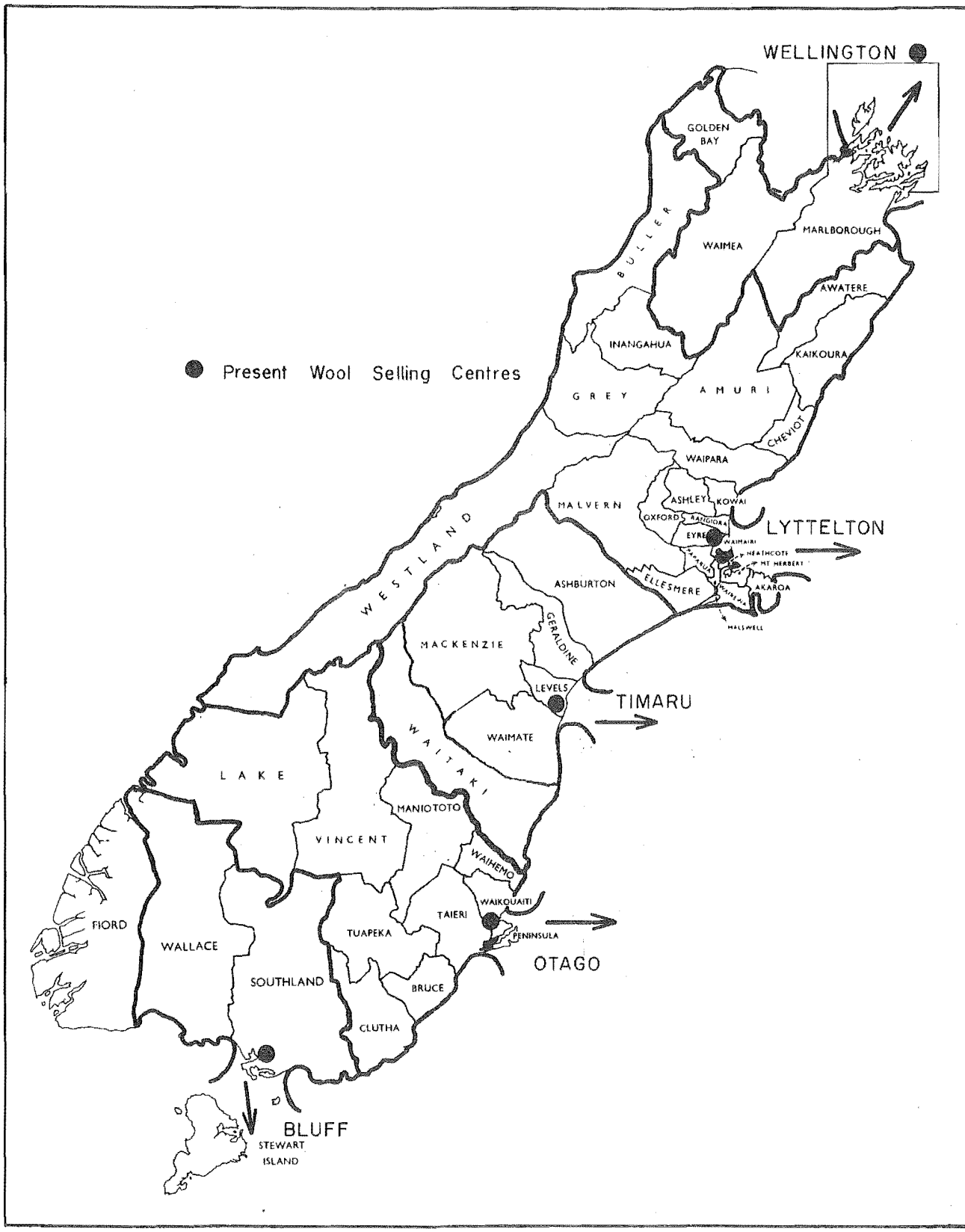


Figure 10 Simulated Wool Movements: Shipping Possible Through Wellington, Lyttelton, Timaru, Otago and Bluff

The inclusion of port costs reduces the flow of wool through Wellington. When only the costs incurred in moving wool to the ports were examined, shipments from the Golden Bay, Waimea, Marlborough, Awatere and Kaikoura counties were seen to move to Wellington (Table 23). Wool from Kaikoura moves south when port costs are included, due to Wellington's handling costs being higher than those at Lyttelton or Timaru.

It is not possible to compare this optimal wool movement pattern with the existing pattern, as the nature of existing wool flows from counties to selling centres and ports is not known. However the percentage of wool sold at each selling centre under the optimal and existing movement patterns may be compared.[7]

Table 25 suggests that it would be more efficient, in terms of minimising transport costs, if some of the wool now being sold at the Christchurch and Dunedin sales were diverted to Timaru. In addition some wool from the north of the South Island should be sold at Wellington in preference to Christchurch.

Table 25

WOOL SALES BY SELLING CENTRE

SELLING CENTRE	PERCENTAGE OF SALES	
	Existing(1)	Optimal
Wellington	-	5
Christchurch	26	18
Timaru	16	24
Dunedin	25	20
Invercargill	33	33

SOURCE: (1) Statistical Analysis of New Zealand Wool Production and Disposal, 1969-70 Season. New Zealand Wool Commission.

When all wool shipments are concentrated through only one South Island port, Timaru offers a very slight saving over Otago (see Table 24). However should wool shipments be permitted through Wellington, then Otago/Wellington would be the least cost port combination.

Under a two port loading system Timaru/Bluff would offer savings of more than $150,000 over the next cheapest combination (Lyttelton/Bluff). This ranking is not altered with the inclusion of Wellington. The derived port hinterlands under the Wellington/Timaru/Bluff and Wellington/Lyttelton/Otago port systems are shown in Figures 11 and 12 respectively.

The distribution systems presented in Table 24 all assume that the number of wool selling centres may be reduced according to the number of ports through which shipment is permitted. For example, the Timaru/Bluff shipping proposal assumes that there will be only two South Island wool selling centres - located at Timaru and Bluff. If it was decided to reduce the number of wool shipment ports but retain the present number of selling centres, total system costs would increase as the advantage of tapering rail rates with distance would not be so marked. For example, the cost of moving one bale of wool from Waipara to Timaru would be $2.98 (Waipara to Christchurch $1.22 plus Christchurch to Timaru $1.76), whereas if the movement had been direct, the cost would have been $2.61 - a saving of $0.37.

Selling centre hinterlands (where wool must be sold through the nearest centre) are shown in Figure 13. These hinterlands differ from the port hinterlands previously

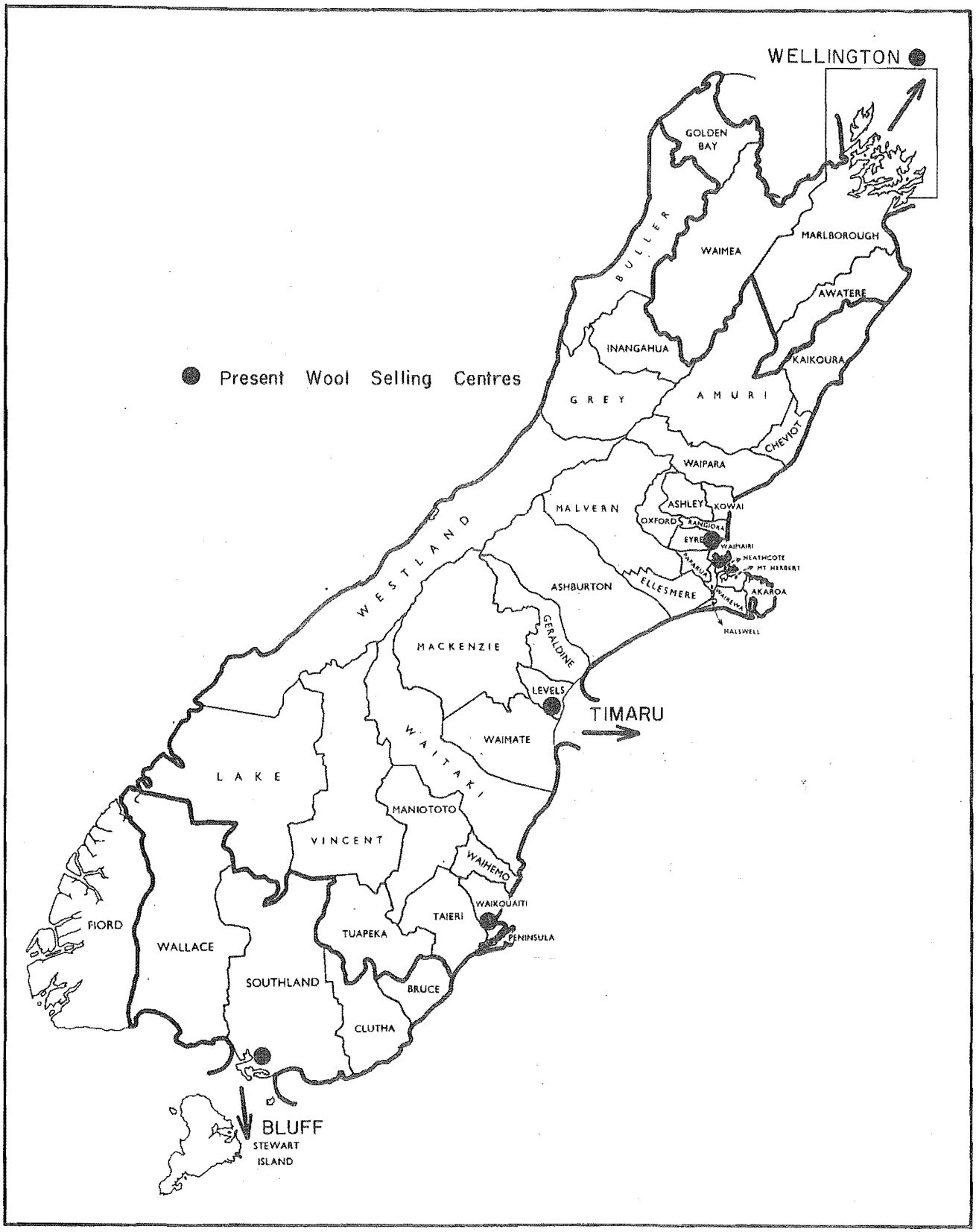


Figure 11 Simulated Wool Movements: Shipping Possible Through Wellington, Timaru and Bluff

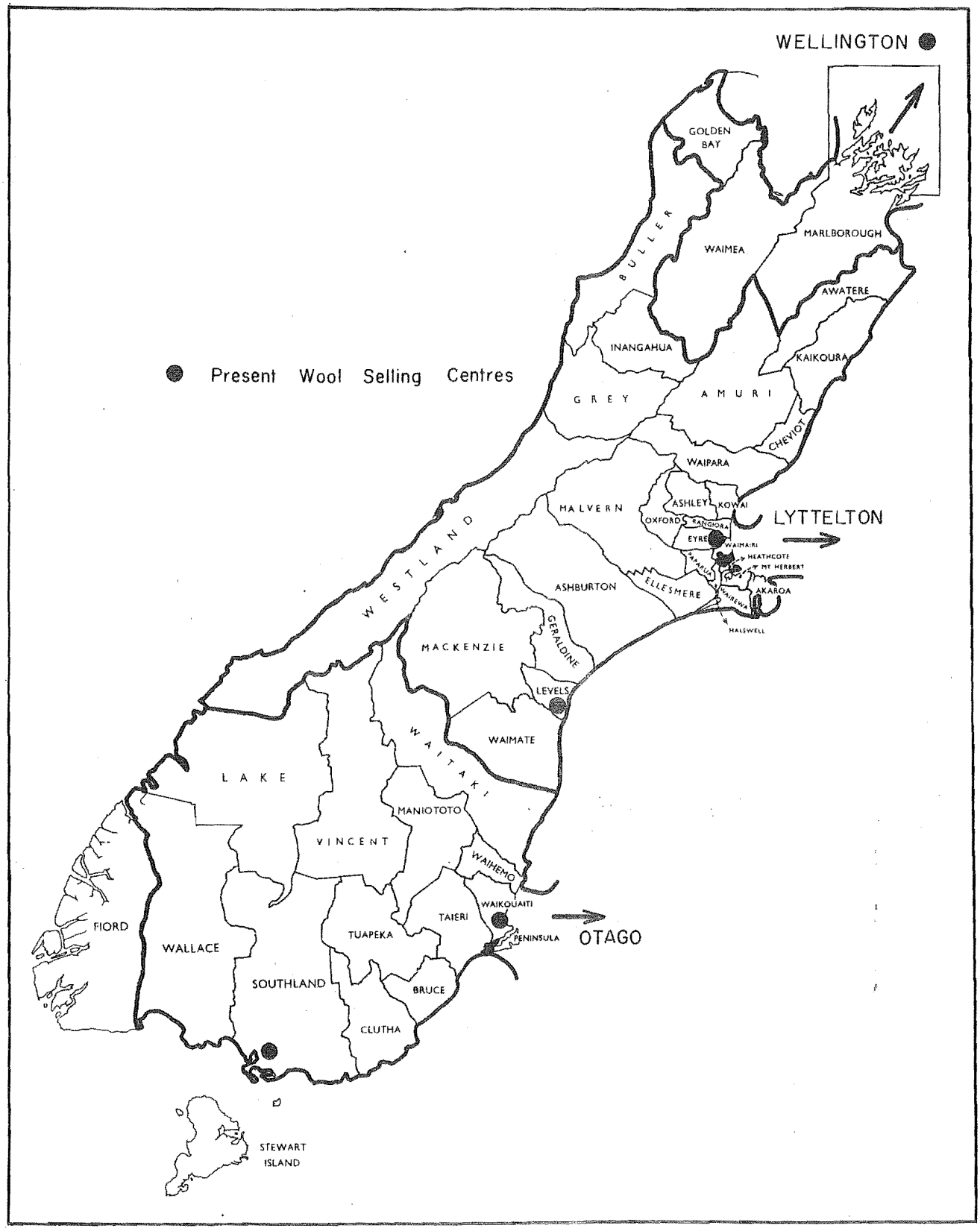


Figure 12 Simulated Wool Movements: Shipping Possible Through Wellington, Lyttelton and Otago

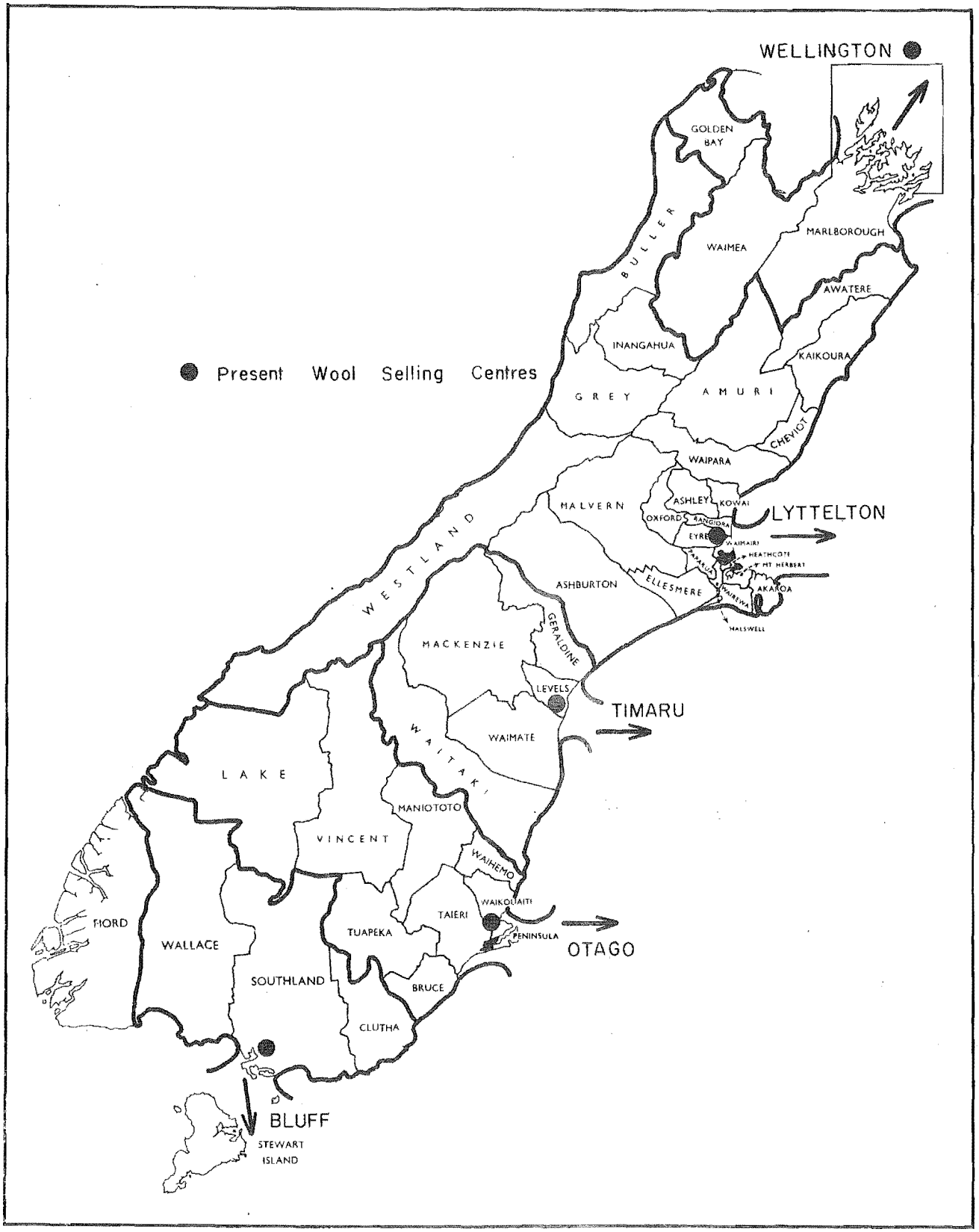


Figure 13 Simulated Wool Movements: Shipping Possible Through Wellington, Lyttelton, Timaru, Otago and Bluff With Wool Sold at Nearest Auction Centre

derived (see Figure 10). Wool from Clutha is now sold at Invercargill while Ashburton wool is diverted from Timaru to Christchurch. Under these restricted conditions, system costs, when wool may be exported through all ports, increase from $3,234,944 to $3,272,202; through Timaru/Bluff from $3,646,563 to $3,883,588; and through Wellington/Otago from $4,267,513 to $4,491,823.

Harbour improvement rates were included in the previous analyses and to test the sensitivity of port combinations to changes in port costs several combinations were examined with these rates removed. (The harbour boards at Nelson, Lyttelton and Otago levy a harbour improvement rate on cargo passing over their wharves). As shown by Appendix XXV the exclusion of this cost does not affect the rankings of the various port combinations. Under the two-port system Timaru/Bluff remains the cheapest port combination, although if all wool was handled through only one South Island port, Otago would replace Timaru as that port.

The ability of the wool distribution system to handle the increased movements which would result from concentrating wool shipments through a limited number of ports, was examined. The volume of wool sold and shipped during a peak month (January), was calculated, and this amount then forced through a wool network with capacity constraints. (These constraints were placed on the various ports and dump stores). The effects of these capacity constraints on movements through selected port combinations are shown in Table 26.

Table 26

PORT AND DUMP STORE CAPACITY CONSTRAINTS TO WOOL MOVEMENTS

Bales per Month

PORT COMBINATIONS	MAXIMUM THROUGHPUT		WOOL UNABLE TO BE HANDLED	
	Port	Dump Store	Port	Dump Store
One-Port Loading				
Lyttelton	77,500	92,500	40,260	25,260
Timaru	95,000	91,250	22,760	26,510
Otago	65,000	102,500	52,760	15,260
Bluff	117,760	117,760	-	-
Two-Port Loading				
Timaru	66,758	66,758	-	-
Bluff	51,002	51,002	-	-
Timaru	51,736	51,736	-	-
Otago	65,000	57,500	8,524	-
Lyttelton	47,167	47,167	-	-
Otago	65,000	57,500	13,093	-
Lyttelton	51,736	51,736	-	-
Bluff	66,024	66,024	-	-

(I) A total of 117,760 bales of wool were generated through the distribution system.

SOURCE: Port and Dump Store capacities were taken from Wool Flow Advisory Committee (1968, 48-67).

Under a one-port loading system only Bluff would have the capacity to dump and load all the wool presented during January. Dumping facilities at most of the ports would be unable to handle the increased flow, even if worked to their maximum capacity. Under the two-port system Lyttelton/Bluff and Timaru/Bluff would have sufficient port and dumping capacity to handle the extra requirements, but severe port congestion would occur at Otago. Dump stores would not create bottlenecks, as occurred under one-port loading.

This simple capacity execise can only be viewed as approximating the actual system, as the values reflecting both dumping and port capacity appear to be much higher than those achieved in reality. Moreover, any diversion of wool through a reduced number of ports would be accompanied by investments in new handling facilities which would increase the system's capacity.(8) The network analysis technique is a powerful tool in that it permits capacity constraints to be considered, but a detailed study would be required to determine appropriate throughput capacities for all the system's many facilities.

This section has shown Otago to be the port minimising internal transport and port costs should shipping developments require all South Island wool being exported through one port.(9) Under a two-port system Timaru/Bluff would be the cheapest combination. System repercussions which are estimated to accompany these diversion schemes are presented in Table 27. The selection of Otago as the sole South Island wool export port would result in that port's revenue increasing by over $350,000, with corresponding losses being experienced by the other ports.

Table 27

IMPACT OF WOOL AGGREGATION SCHEMES ON SOUTH ISLAND HARBOUR BOARDS AND REGIONAL ECONOMIES

HARBOUR BOARD	OPTIMAL THROUGHPUT(1) (Tons)	ONE-PORT LOADING Revenue Impact		TWO-PORT LOADING Revenue Impact	
		Harbour Board (Dollars)	Region(2) (Dollars)	Harbour Board (Dollars)	Region (Dollars)
Marlborough	7,105	- 10,267	- 28,690	- 10,627	- 28,690
Nelson	3,381	- 5,886	- 13,591	- 5,886	- 13,591
Lyttelton	23,153	- 57,720	- 165,945	- 57,720	- 165,945
Timaru	34,035	- 150,571	- 264,960	+ 376,867	+ 663,172
Otago	29,348	+ 391,085	+ 954,481	- 79,357	- 206,271
Southland	47,610	- 192,440	- 360,717	+ 240,276	+ 452,256

(1) Tonnage handled by ports to minimize internal transport costs, (6.5 Bales = 1 Ton).

(2) This takes into account the income lost by waterside workers, as well as the revenue lost by harbour boards, and represents the maximum revenue gain or loss experienced by each region.

SOURCE: Harbour Board revenue receipts per ton and regional income multipliers from previous calculations.

A two-port system would increase the revenue received by Timaru and Bluff by over $250,000 and $310,000 respectively, with consequent advantages to their local business communities.

Future Developments - The large scale use of containers for the transport of wool was not evaluated, as industry representatives are not necessarily convinced that the container concept will enable transport costs to be stabilised. Many view the 12-bale strapped unit as a cheaper method of handling wool.(10) Since wool is a low value high volume product, the advantages offered by containers are much less than in the case of a relatively high value low volume product (such as cartoned meat and dairy produce). While wool will move in containers where it forms a minor proportion of the total trade (for example the ECNA trade), other trades may justify a method of shipment more suited to the nature of the product.(11)

5.4 Evaluation of Alternative Meat Distribution Systems

Although detailed costings of frozen meat movements have been made, as was the case with wool, most research in this field has tended to be retrospective. The cost of transporting meat from freezing works to overseas markets has been studied by the Ministry of Transport(1970a) and internal movement patterns determined. No attempts have been made to use this detailed information to compare the costs of alternative distribution schemes, or to calculate the effects of such schemes on internal meat movement patterns. Reference to the South Island meat diversion system illustrates

the degree to which changing transport technology can influence commodity movement patterns.

The need to achieve faster meat loading rates, so that the amount of idle time ships spent in port could be minimised, encouraged the Southland and Timaru Harbour Boards to install all-weather mechanical meat loaders during the mid-sixties. With the construction of these facilities a trial South Island meat diversion system was commenced. Following a study by the Transport Commission in October 1968 this scheme was allowed to continue on a permanent basis. As a result of this decision meat loading rates at these two ports have been substantially increased and a marked re-orientation of meat movements within the South Island has occurred (see Figure 14). Large volumes of meat processed within the Otago region are shipped through Timaru and Bluff, while Timaru also draws meat from the Canterbury region.

Uncertainty similarly surrounds the type of shipping which may carry New Zealand's frozen meat products in the future. Many in the industry have welcomed the introduction of containers, and some have suggested that this form of transport is essential if the industry is to remain competitive in certain markets. The ECNA trade is now fully containerised and a limited service will soon commence to the United Kingdom. However there are many advocates of the palletised system and some shipping companies have recently purchased new multi-purpose shipping (see Chapter IV). A meat industry spokesman was recently reported as stating that lamb exporters may be forced to boycott container services unless freight

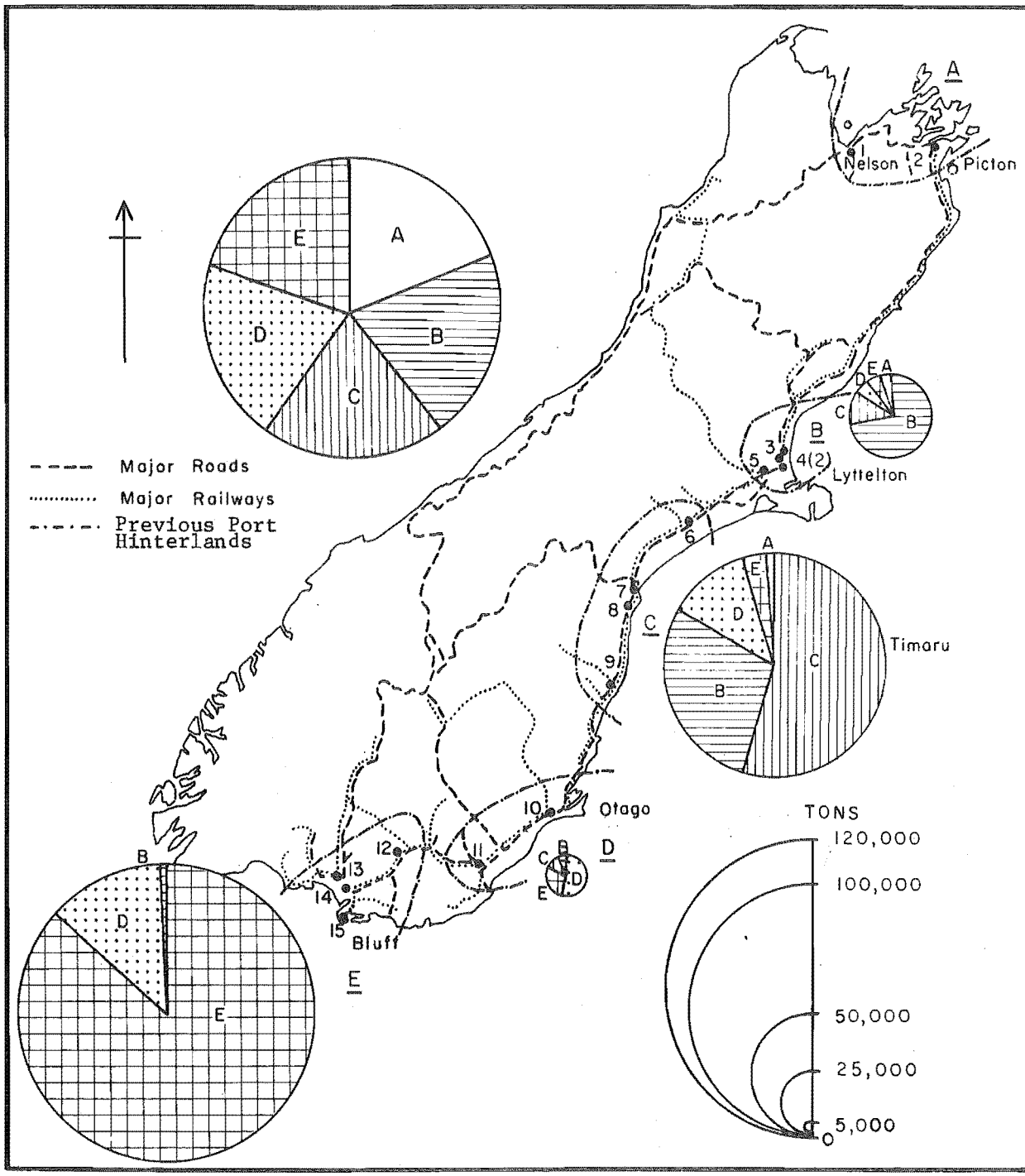


Figure 14 Origin, Volume, and Port of Shipment of South Island Export Meat, 1969/70

IDENTIFICATION OF FREEZING WORKS IN FIGURE 14

		Freezing Works	Location
1.		Nelson Freezing Co. Ltd.	Stoke
2.		N.Z. Refrigerating Co. Ltd.	Picton
3.		North Canterbury Sheep Farmers Co-operative Freezing Co. Ltd.	Kaiapoi
4.	(2)	Thomas Borthwick & Sons (A'Asia) Ltd.	Belfast
		Canterbury Frozen Meat Co.	Belfast
5.		N.Z. Refrigerating Co. Ltd.	Islington
6.		Canterbury Frozen Meat Co. Ltd.	Fairfield
7.		N.Z. Refrigerating Co. Ltd.	Smithfield
8.		Canterbury Frozen Meat Co. Ltd.	Pareora
9.		Waitaki Farmers' Freezing Co. Ltd.	Pukeuri
10.		N.Z. Refrigerating Co. Ltd.	Burnside
11.		South Otago Freezing Co. Ltd.	Balclutha
12.		Southland Frozen Meat Co. Ltd.	Mataura
13.		Southland Frozen Meat Co. Ltd.	Makarewa
14.		Alliance Freezing Co. (Southland) Ltd.	Lorneville
15.		Ocean Beach Freezing Co. Ltd.	Ocean Beach

rates were reduced.[12] (Freight rates are calculated per container rather than by weight, resulting in carcase shipping rates in containers effectively being 28 percent higher than that charged by conventional services). With further streamlining of internal cargo movements being considered (and it was recently announced that additional meat exports will be diverted through Napier), it is important that the internal ramifications of these schemes be carefully evaluated. Transport costs incurred in the aggregation of frozen meat exports at certain South Island ports are examined.

Frozen Meat Movement Data - Meat production figures were obtained from all South Island freezing companies for the period 1960/61 to 1969/70. To eliminate distortion resulting from seasonal factors, meat production for the 1970/71 season was forecast on the basis of these previous trends. Forecasts were made for each individual freezing works as although the South Island's meat production has been increasing at a steady rate, regional growth rates have been uneven.

Inland transport and port charges were collected from transport operators and harbour boards respectively (see Appendix XXIV and XXVI).

The procedure followed was similar to that used in the wool movement analysis. Frozen meat tonnages from each freezing works were generated through a network representing the meat distribution system so that movement costs to ports would be minimised. The network consisted of freezing works, roads, railway lines and ports, with the network so constructed

that meat from each works could move to any port (a total of 154 links and 42 nodes).

Discussion of Results - Transport costs incurred in moving the South Island's predicted meat production from freezing works to export port are given in Table 28. When shipment is possible through all ports the total cost is $1,256,847, and as the number of ports are reduced the internal transport costs naturally rise. Should meat exports be aggregated at only one port, Bluff - despite its relatively isolated location - would be the most favourable port. This is due to the heavy concentration of meat production within its hinterland (during 1969/70 the Southland province produced over 42 percent of the South Island's total meat exports).

Calculations made by the Otago Harbour Board (1971, 20) suggested that if meat had to be exported through only one South Island port, total "ton-miles" would be minimised when meat was exported through Otago. Their findings are compared with the results from Table 28. (see Table 29).

Table 29

AGGREGATION OF FROZEN MEAT AT ONE PORT

PORT	AGGREGATION "COSTS"	
	Otago Study (Ton-miles)	Present Study (Dollars)
Lyttelton	57,032,489 (56%) (1)	4,494,947 (19%)
Timaru	42,096,710 (15%)	4,048,206 (7%)
Otago	36,575,136 -	3,990,896 (5%)
Bluff	43,835,340 (20%)	3,788,328 -
Wellington	117,109,538 (220%)	9,142,892 (141%)

(1) The cost of aggregating cargoes is expressed as a percentage of the cost at the least-cost port.

SOURCE: Otago Harbour Board (1971).

Table 28

TRANSPORT COSTS INCURRED IN MOVING FROZEN MEAT FROM FREEZING WORKS TO PORT

1970/71 Production

PORT COMBINATIONS	CARGO (Tons)	COST (Dollars)
No South Island Port		
Wellington	272,978	9,142,892
One South Island Port		
Lyttelton	272,978	4,494,947
Timaru	272,978	4,048,206
Otago	272,978	3,990,896
Bluff	272,978	3,788,328
All Ports Included		
Picton	5,780	
Nelson	4,333	
Lyttelton	53,341	
Timaru	56,796	
Otago	37,991	
Bluff	114,737	1,256,847

PORT COMBINATIONS	CARGO (Tons)	COST (Dollars)
Two South Island Ports		
Lyttelton	106,567	
Otago	166,411	2,920,996
Lyttelton	120,250	
Bluff	152,728	2,083,767
Timaru	120,250	
Otago	152,728	3,084,129
Timaru	134,554	
Bluff	138,421	2,185,658
Wellington	10,113	
Lyttelton	96,454	
Otago	166,411	2,877,212
Wellington	10,113	
Lyttelton	110,137	
Bluff	152,728	2,039,983
Wellington	10,113	
Timaru	110,137	
Otago	152,728	3,010,671
Wellington	10,113	
Timaru	124,441	
Bluff	138,424	2,112,199

Whereas the Otago study found that the movement of meat to Bluff was 20 percent more "costly" than through its own port, this study has shown that the choice of Bluff as the only meat exporting port would in fact be 5 percent cheaper than Otago. One reason which may account for these different findings is that two different years were compared (the Otago study considered 1969 meat movements). But the main reason is that the calculation of ton-miles does not accurately reflect actual transport costs. Ton-miles assume that the relationship between distance and costs will be linear (with one mile being the same as the next), whereas rail costs, and charges, taper markedly with distance.(13)

Under a two-port meat loading scheme the combination of Bluff and Lyttelton will offer slight savings over the Bluff and Timaru combination. Allowing shipments through Wellington does not alter these rankings, though the difference in cost between the two best combinations is reduced (see Table 28).

The introduction of port costs into the analysis alters the relative costs of some port combinations (see Table 30). Bluff retains its position as the cheapest single-port through which to concentrate meat shipments, while Timaru displaces Otago as the second choice. This is on account of the savings in port charges shippers through Timaru would enjoy.

Whereas the Lyttelton/Bluff combination incurred the lowest internal aggregation costs, the Timaru/Bluff combination results in the lowest overall costs ($4,258,481 as against $4,411,259). Such a finding would be anticipated as these two ports are equipped with all-weather mechanical meat loaders.

Table 30

-- TRANSPORT COSTS INCURRED IN MOVING FROZEN MEAT FROM FREEZING WORKS TO SHIP

1970/71 Production

PORT COMBINATIONS	CARGO (Tons)	COST (Dollars)
No South Island Port		
Wellington	272,978	12,080,136
One South Island Port		
Lyttelton	272,978	7,183,781
Timaru	272,978	6,191,083
Otago	272,978	6,750,704
Bluff	272,978	6,021,288
All Ports Included		
Picton	5,780	
Nelson	4,333	
Lyttelton	53,341	
Timaru	56,796	
Otago	37,991	
Bluff	114,737	3,631,140

PORT COMBINATIONS	CARGO (Tons)	COST (Dollars)
Two South Island Ports		
Wellington	10,113	
Lyttelton	96,454	
Otago	166,411	5,546,810
Wellington	10,113	
Lyttelton	110,137	
Bluff	152,728	4,411,259
Wellington	10,113	
Timaru	110,137	
Otago	152,728	5,456,437
Wellington	10,113	
Timaru	124,441	
Bluff	138,424	4,258,481

To take into account any likely changes in the pattern of production, forecasts of regional meat production in 1974/75 were made.[14] When these new production figures were generated through the distribution system no change in the rankings of the various port combinations occurred (see Table 31). Production increases within the Southland area were of such magnitude that the relative advantage of Bluff as the sole export port increased. Timaru remained the second cheapest port followed by Otago and Lyttelton.

The two-port combination saw the position of the Timaru/Bluff combination strengthened, followed as previously by Lyttelton/Bluff.

Future internal meat movement patterns are uncertain. Although containers will increasingly be used for the shipment of meat, especially packaged meat, their widespread introduction to the South Island may be delayed by the presence of the mechanical loaders at Timaru and Bluff. Much effort was spent in attempting to compare the relative costs of aggregating meat at these loaders and at container ports. Details on container stowage rates were obtained from shipping companies but it proved impossible to obtain even approximate container freight charges from the Railways Department. Geddes(1971) suggested that the introduction of containers may reduce railway costs by up to 30 percent, but he also indicated that a clear railway freight structure for the movement of containers had still to be finalised.

This section has shown that the concentration of all South Island meat exports through Bluff would minimise the

Table 31

COSTS INCURRED IN MOVING FROZEN MEAT
FROM FREEZING WORKS TO SHIP

1975 Production Estimates

PORT COMBINATIONS	CARGO (Tons)	COST (Dollars)
No South Island Port		
Wellington	282,552	12,477,233
One South Island Port		
Wellington	10,790	
Lyttelton	271,762	7,293,050
Wellington	10,790	
Timaru	271,762	6,265,335
Wellington	10,790	
Otago	271,762	6,625,966
Wellington	10,790	
Bluff	271,762	5,628,854
Two South Island Ports		
Wellington	10,790	
Lyttelton	102,157	
Otago	169,605	5,750,756
Wellington	10,790	
Lyttelton	116,851	
Bluff	154,911	4,559,112
Wellington	10,790	
Timaru	116,851	
Otago	154,911	5,462,987
Wellington	10,790	
Timaru	129,693	
Bluff	142,069	4,391,669

inland transport and port costs of a one-port meat loading system. Under a two-port system Timaru/Bluff would be the port combination producing the lowest internal distribution costs ($152,778 cheaper than the Lyttelton/Bluff combination). System repercussions which are anticipated to accompany these meat aggregation schemes are shown in Table 32. Under the "optimal" one-port system, which would see shipments concentrated through Bluff, the Southland Harbour Board's annual revenue from the meat trade would exceed $1.1 million, and over $2 million in revenue would be generated within its surrounding region. The Timaru Harbour Board would suffer the greatest absolute revenue loss from this scheme ($251,266 per annum).

The two-port system, with meat being exported through Timaru and Bluff would produce similar benefits to the Timaru and Southland regions. Such a diversion system would generate approximately $1 million in revenue within the two regions.A corresponding loss of $382,316 and $267,020 would be experienced by the Canterbury and Otago regions respectively.

The approach developed and demonstrated in this section is shown to be capable of calculating both the internal transport costs associated with various shipping proposals, and their resultant regional implications. No conclusions as to the "optimal" port system may be reached without a similar examination of shipping costs, but the method does allow decision-makers to predict the internal ramifications of shipowners' proposals.

Table 32

IMPACT OF MEAT AGGREGATION SCHEMES ON SOUTH ISLAND HARBOUR BOARDS AND REGIONAL ECONOMIES

HARBOUR BOARD	OPTIMAL THROUGHPUT (1) (Tons)	ONE PORT LOADING Revenue Impact		TWO-PORT LOADING Revenue Impact	
		Harbour Board (Dollars)	Region (2) (Dollars)	Harbour Board (Dollars)	Region (Dollars)
Marlborough	5,780	- 8,352	- 23,339	- 8,352	- 23,339
Nelson	4,333	- 7,544	- 17,417	- 7,544	- 17,417
Lyttelton	53,341	- 132,979	- 382,316	- 132,979	- 382,316
Timaru	56,796	- 251,266	- 442,153	+ 550,527	+ 968,764
Otago	37,991	- 102,728	- 267,020	- 102,728	- 267,020
Southland	114,737	+1103,377	+2,076,816	+ 559,510	+1,053,131

(1) Tonnage handled by ports to minimize internal transport costs.

(2) This takes into account the income lost by waterside workers, as well as the revenue lost by harbour boards, and represents the maximum revenue gain or loss experienced by each region.

SOURCE: Harbour Board revenue receipts per ton and regional income multipliers from previous calculations.

Footnotes

(1) The Metra Report is an obvious exception, though this was performed by an overseas firm.

(2) That is, the implications to particular sections of the transport system will be demonstrated.

(3) Please note that in editing this section a small error was discovered in Figure 5. Lyttelton's level of manure imports in 1968 should have been shown as 152,623 tons. The "other" tonnage should be reduced by this corresponding amount.

(4) The main exception to this trend is at Bluff, where a 15 percent increase in wool loading rates occurred between 1965 and 1970.

(5) The advantage in using average wool loading costs per ton, as against wharf handling charges is that average costs include both ship and wharf operations.

Many harbour boards have criticised the wharf handling charges set by the Waterfront Industry Commission, some even claim that they discriminate against those ports which have installed modern facilities. For example, it is argued that wharf handling charges at ports which load and unload direct ships side are often lower than at those ports working through an adjacent transit shed. The point which is often ignored, but which is covered by the use of average costs, is that the rate at which cargo is kept up to the hook is a crucial factor in determining the level of charges. If a port which loaded wool direct ships side was able to deliver cargo to the hook at similar rates to those achieved by a port working through a transit shed, the first port would naturally enjoy lower wharf handling charges.

The relationship between wool loading rates per gross gang hour and average cost per ton was tested at those New Zealand ports which exported more than 5,000 tons of wool during 1969/70. A correlation coefficient of -0.82 was obtained, suggesting, (as would be anticipated) that average wool loading costs per ton decrease as loading rates increase. Therefore the average costs per ton, together with wharfage and harbour improvement rates, can be assumed to reflect the efficiency of various ports.

(6) Although results were derived for a large number of port combinations, in general only those involving one-port or two-port loading are discussed, as this was the number the New Zealand Wool Board suggested as being the most advantageous.

(7) Existing wool movements through a port are assumed to represent the amount of wool sold at the centre adjacent to that port. This enables wool sold at each centre to be expressed as a percentage of total sales.

(8) As Battelle (1971,46) noted, "... a probable effect of handling wool at only two ports would be to develop specialised machinery at those ports with a corresponding increase in productivity, a factor which would further reduce costs...". As well as handling equipment, investment might be needed in additional wharf side transit sheds to enable full utilisation to be made of this equipment. The complete distribution system must be examined as irrespective of the suitability or efficiency of certain facilities, the system itself will only be as efficient as its weakest link.

(9) Assuming that some wool may also be shipped through Wellington.

(10) This opinion was conveyed in submissions made by the New Zealand Wool Board to Royal Commission on containers, June 1972.

(11) The Japanese and Continental trades may merit another form of shipment.

(12) Reported in the New Zealand Herald, 16 September 1972.

(13) In this situation it would be cheaper to move a certain tonnage of meat over longer distances, than it would be to move a larger tonnage over smaller distances.

(14) These forecasts were based partly on historical trends, and partly on discussions with staff attached to the New Zealand Meat Board and New Zealand Meat and Wool Boards' Economic Service.

CHAPTER VI

COASTAL SHIPPING AND CONTAINER AGGREGATION

In their survey of the coastal shipping industry, the Commission of Inquiry into New Zealand Shipping (1971,220) found that "... the coastal trade as it exists in New Zealand at the present time, is a proper subject for concern. We do not think it can continue in its present form for very long...". It is apparent that the future role of coastal shipping in New Zealand's transport system is uncertain. A review is therefore made of coastal cargo trends during the period 1960 to 1970, and factors contributing towards these trends are discussed. The feasibility of introducing a coastal feeder system to aggregate containers, and the arguments supporting the location of a container port in the South Island are also studied.

6.1 Coastal Cargo Trends

The tonnages of coastal cargo received at South Island ports during the period 1960 to 1970 are shown in Figure 15.[1] This Figure would appear to suggest that far from being in a depressed state the coastal shipping industry is experiencing increased activity, the traffic handled at most ports having steadily increased over the period. However when motor spirits and petroleum products are excluded from these totals a very different impression is obtained. Apart from Picton, which is a rail ferry terminal, only Lyttelton

has experienced an increase in general cargo coastal inwards traffic. Other ports (in particular Nelson), have witnessed static, and in some cases sharp reductions in the level of their general cargo trade.

A similar pattern is evident for the coastal outwards trade (see Figure 16). Substantial annual increases have been recorded at Picton, and Lyttelton's trade, though subject to fluctuations, has risen slightly. With the shipment of serpentine to the North Island during the mid-sixties Nelson gained additional coastal cargo, but with the cessation of this trade the port's tonnage has steadily declined. Traffic through the remaining ports has generally been static, even at Otago which is linked with Auckland and Wellington by a modern roll-on/roll-off coastal service. The shipment of wheat and grain products forms the basis of the trade through Timaru, Oamaru and Bluff.

In comparison, the volume of freight and motor vehicles carried by the Cook Strait rail ferries has increased dramatically (see Table 33).[2]

Table 33

TRENDS IN COOK STRAIT RAIL FERRY AND RAIL/AIR CARGO MOVEMENTS, 1963/1970

Manifest Tons

YEAR	MOTOR VEHICLES[1]	FREIGHT TRAFFIC	TOTAL TRAFFIC
1963	107,370	103,561	210,931
1964	186,810	250,979	437,789
1965	227,960	311,057	539,017
1966	256,980	371,777	628,757
1967	303,450	492,043	795,493
1968	330,335	564,646	894,981
1969	380,335	689,979	1,070,314
1970	445,275	835,586	1,280,861

(1) Passengers' Motor Vehicles plus Lorries and Trade Cars.

SOURCE: Marlborough Harbour Board and New Zealand Railways.

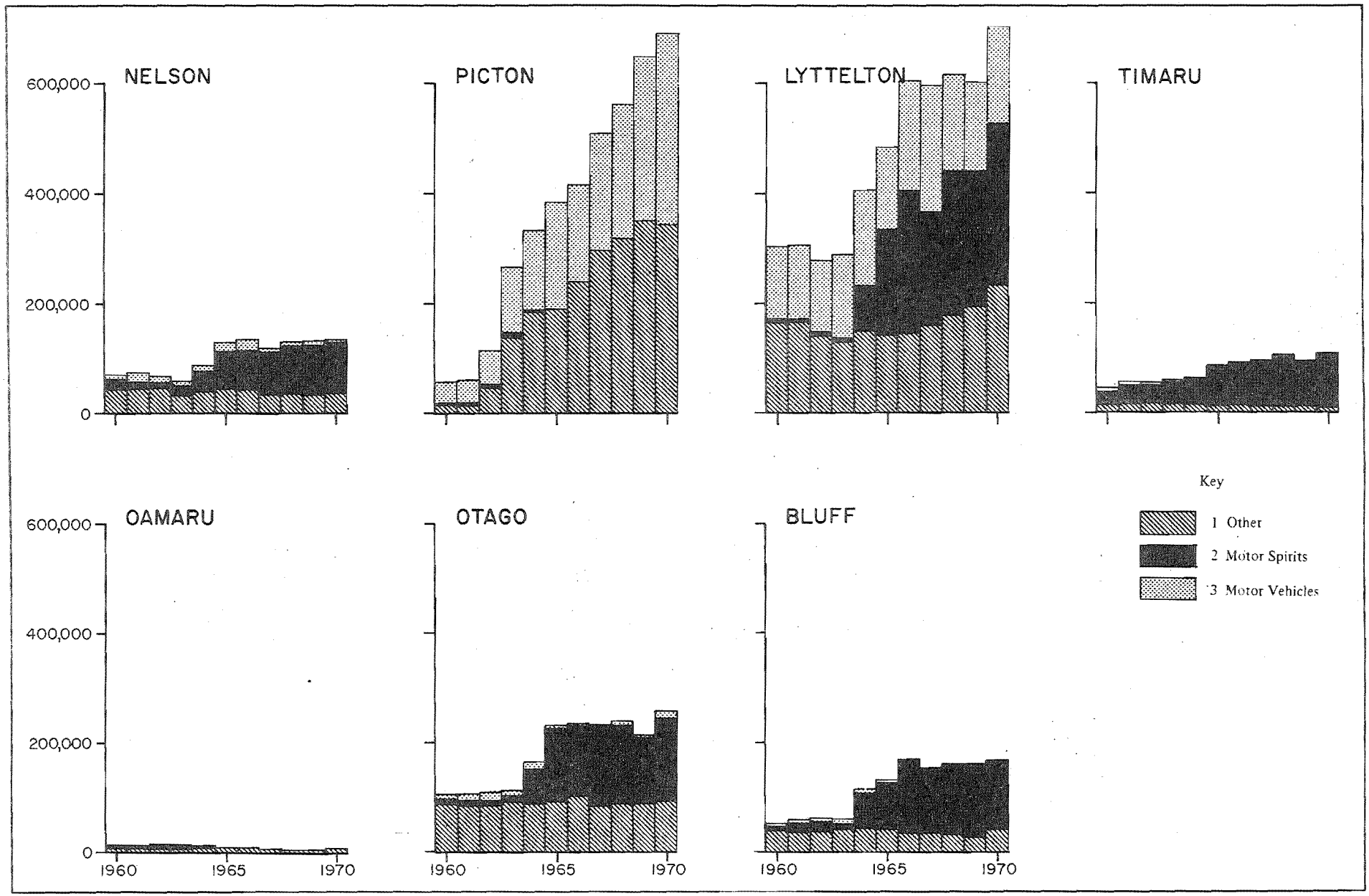


Figure 15 Cargo Trends: Coastal Inwards, 1960/70

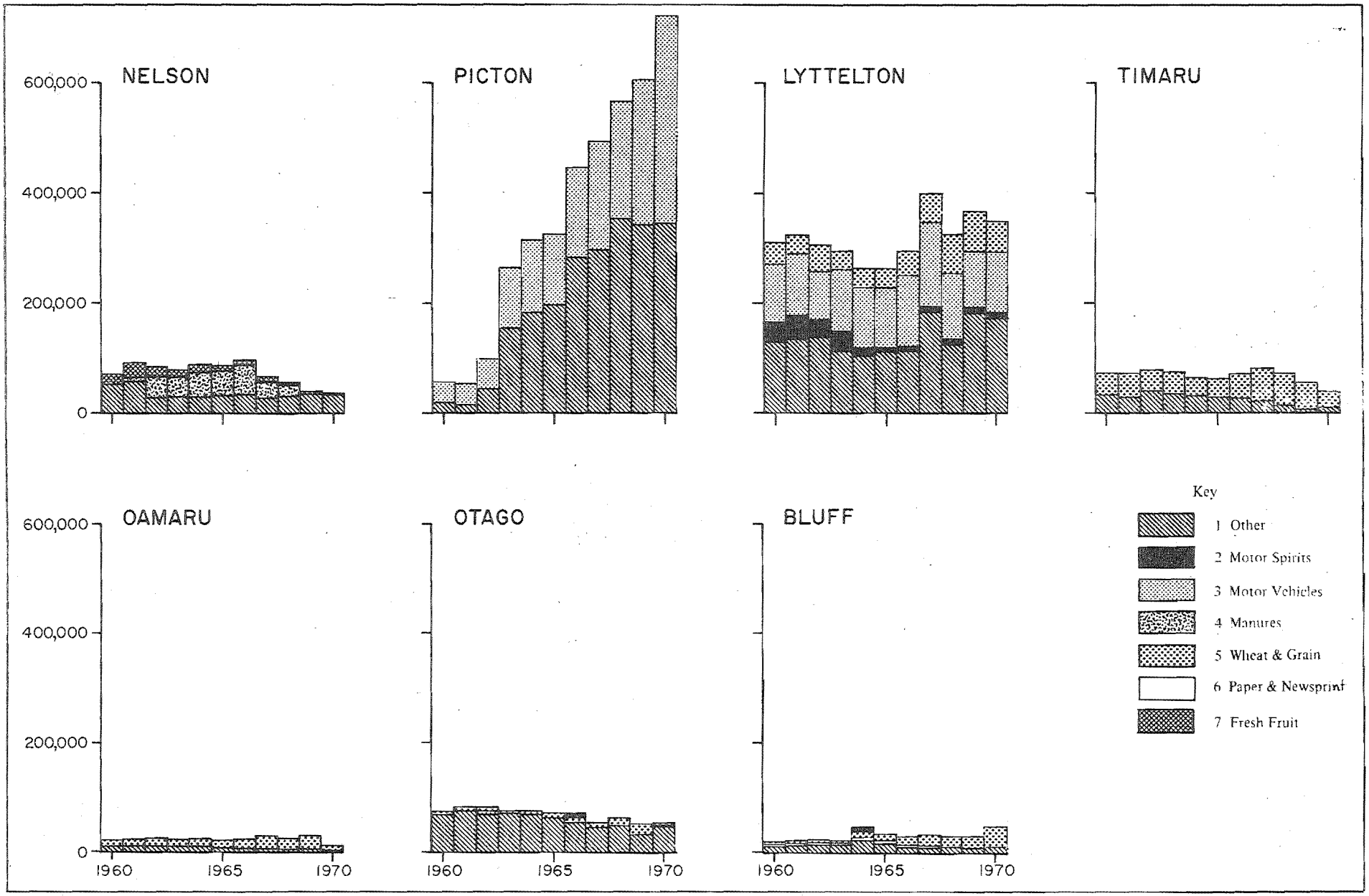


Figure 16 Cargo Trends: Coastal Outwards, 1960/70

During the last few years there has been increasing pressure for New Zealand to formulate a rational transport policy. Frequent recommendations have been made that "each mode of transport should carry the traffic to which it is best suited so that economic resource cost will be minimised". In view of the two preceeding Figures it would appear that the only commodities suited to the inherent advantages of coastal shipping are motor spirits and petroleum products and some bulk agricultural produce.(3) Even the introduction of modern roll-on/roll-off vessels handling general cargo in a unitised fashion, and providing regular and frequent services, have been unable to stem the diversion of general cargo to the Cook Strait rail ferry service. Coastal shipping interests have often urged that steps should be taken to allocate freight or trades to the different transport modes, according to their inherent advantages, but as noted by the Commission of Inquiry into New Zealand Shipping (1971,221), it is most unlikely that the Government would ever direct a shipper to use a particular transport mode.

Discussion of Trends - Despite statements seeking to suggest otherwise, the introduction of the Cook Strait rail ferry service has had a serious effect on New Zealand's other coastal shipping services (Commission of Inquiry into New Zealand Shipping 1971,220).(4) Referring to Table 34, total inter-island freight increased from 1,490,408 tons in 1964 to 2,371,103 tons in 1970, an overall increase of 50 percent or approximately 9 percent per year.(5) But while freight handled by the rail ferries increased by 193 percent (32 percent per year), inter-island movements by other shipping services remained at virtually a constant level (a 5 percent increase over the six year period).

Table 34

TRENDS IN INTER-ISLAND FREIGHT MOVEMENTS, 1964/1970

Manifest Tons

YEAR	COOK STRAIT RAIL FERRY			CONVENTIONAL COASTAL SHIPPING FREIGHT	TOTAL FREIGHT
	Motor Vehicles	Freight	Total Freight		
1964	186,810	250,979	437,789	1,052,619	1,490,408
1965	227,960	311,057	539,017	1,045,652	1,584,669
1966	256,980	371,777	628,757	1,120,242	1,748,999
1967	303,450	492,043	795,493	1,176,045	1,971,538
1968	330,335	564,646	894,981	1,124,825	2,019,806
1969	380,335	689,979	1,070,314	1,090,188	2,160,502
1970	445,275	835,586	1,280,861	1,090,242	2,371,103

SOURCE: New Zealand Railways Department; Harbour Board Annual Reports, Trade Statistics and Shipping Manifests.

The point of debate is whether this phenomenal growth in rail traffic resulted from new trade generated by the advantages of the service being offered, or trade diverted from conventional forms of coastal shipping. Motor vehicle movements increased by 82 percent during the period, while those carried by the rail ferries increased by 138 percent. While some of this growth in rail ferry movements may be due to freight capture, a substantial portion of the increase must be due to new traffic being generated by the service.

When motor vehicles are removed from total freight movements, a similar picture prevails. Total inter-island freight (excluding motor vehicles), increased by 32 percent, while the comparable figures for the rail ferries and conventional coastal shipping are 232 and 4 percent respectively.

An analysis of coastal cargo being handled at South Island ports during this period shows the type of commodities which have been diverted to rail. In general, higher-value goods have switched to rail and more bulky and seasonal agricultural products have been retained. The very nature of these products makes it more difficult for shipping companies to provide the type of service necessary to recapture the lost trade. Many of the remaining coastal movements tend to be both seasonal and unbalanced (see Table 35), and this in turn makes the provision of regular shipping services difficult. The majority of coastal exports through Bluff, Timaru and Oamaru are grain or grain products, with 87 percent of Bluff's, 80 percent of Oamaru's, and 84 percent of Timaru's coastal

exports in 1969 coming within this category.

Table 35

DIRECTION OF INTER-ISLAND FREIGHT MOVEMENTS, 1969

Manifest Tons

PORT	DIRECTION OF MOVEMENT(1)	
	North to South	South to North
Nelson	39,000	24,268
Lyttelton	363,451	364,672
Timaru	9,487	60,956
Oamaru	3,026	30,396
Otago	51,142	49,651
Bluff	32,792	43,993

(1) Motor Spirits and Oil Products are Excluded.

SOURCE: Harbour Board Trade Statistics and Shipping Manifests.

There are many and varied reasons to explain why the Railways Department has attracted this inter-island freight from coastal shipping operators.(6) Problems facing shipping companies - for example, port congestion, port labour shortages, industrial disputes, inadequate port facilities and escalating operating costs - all combine to disrupt the service frequency and reliability offered by this mode. Irregular and unreliable services have resulted in many shippers being attracted to rail, despite their often having to pay higher freight costs.

The Railways Department have paid close attention to their customers requirements and have concentrated on providing regular and frequent services - enabling inventory costs to be kept to a minimum. Freight forwarding firms have worked in close conjunction with Railways to provide a convenient

and reliable service. Bulk tonnage contracts and wagon leasing agreements have led to the Railways concentrating on the line-haul operation, with the forwarding companies accepting responsibility for freight solicitation, consolidation, and door-to-door delivery. Rimmer(1972b) has shown that "as the forwarding companies are able to blend cargo to obtain the maximum weight/cubic ratio of the rail wagons, they are able to offer even cheaper rates than the Railways operating in their own right". Such has been the success of these agreements with freight forwarding companies that over 35 percent of the freight traffic carried by the rail ferries is provided by such bulk tonnage contractors.

6.2 Future Coastal Shipping Developments

The recent introduction of the third Cook Strait rail ferry, and the decision to purchase a fourth seems certain to make further inroads into the present coastal shipping services.(7) Freight forecasts compiled by the Railways Department demonstrated the need for the introduction of these additional vessels. A fear held by many harbour boards and shipping operators is that these rail forecasts were based on the assumption that rail would continue to attract freight away from conventional shipping. While the Railways agreed that their forecasts were based on historical patterns of freight movements, they claimed that the majority of this freight was not captured but generated. In addition they pointed to the large amount of freight declined on account of insufficient capacity to carry it as further demonstrating the need for extra ferries.

Rail forecasts suggest that the total demand for inter-island movement via the Cook Strait ferries will reach 1,439,000 deadweight tons by 1975, in comparison with the 507,281 tons carried during the year ended 31 March 1970 (see Table 36).

Table 36

COOK STRAIT FERRY FREIGHT FORECASTS

Deadweight Tons

YEAR	FREIGHT FORECASTS
1971	623,000
1972	769,000
1973	947,000
1974	1,167,000
1975	1,439,000

SOURCE: New Zealand Railways Department.

While a substantial increase in freight demand is forecast, it must be noted that the predicted annual rate of increase is less than that actually experienced during the past six years - between 1964 and 1970 the annual increase was 42 percent; the predicted increase between 1971 and 1975 is 33 percent per annum. However the absolute rate of increase is much greater and there are definite limitations to the validity of a forecast which only considers developments within one section of a transport mode and then assumes that these trends will apply to the mode as a whole.(8)

Objections by coastal shipping operators and harbour boards to the expansion of this rail ferry link have often been regarded as parochial or representing sectarian interests rather than the interests of New Zealand as a whole. While

most harbour boards would agree with the Commission of Inquiry into New Zealand Shipping (1971,222) that "... to try to maintain ships on an uneconomic basis simply in order to keep minor ports alive would be unwise...", the opinion is often voiced that coastal shipping services are being rendered uneconomic through devious rate-cutting practices by the Railways.

Criticism has been levelled at the Railways for their policy of "charging according to what the traffic will bear", and instances where the rail charges between ports were less than the charges between inland areas separated by smaller distances have been noted. (While acknowledging the existense of such rates, the Railways stress these were still economic). By virtue of their protected position - which gives them a virtual monopoly over the majority of intra-island freight movements - together with the size of their organisation, the Railways are able to contest innovations by coastal shippers which they fear may undermine their existing level of operations.(9) While this competition is beneficial to the areas concerned, those areas not served by coastal shipping, or where existing services are in jeopardy, are placed in a relatively unfavourable position.

A policy of basing charges on the level of marginal or incremental costs is economically sound, as once an investment has been made (for example, in a new rail ferry), the recovery of anything more than incremental costs is worthwhile. The national interest requires maximum utilisation of the Railways vast capacity - allowing fixed costs to be spread over a larger volume of traffic. But while this policy of

setting charges above incremental costs according to the alternatives available to the shipper may be beneficial to the mode concerned, at least in the short-run, it is not necessarily advantageous to the whole transport industry. Destructive competition that aims through temporary reductions in price to secure long-run monopoly profits will only harm both the shipper and the consumer.

It appears as though a situation has been reached where coastal operators are reluctant to invest in the modern shipping they realise is required for the New Zealand coastal trade, because of the Railways concentration on long-haul inter-island movements. A pertinent development is that within six months of the takeover of the Union Steamship Company Limited by Tasman Union Limited in December 1971, the combined shipping fleets of the Union, Holm and Anchor Companies had been reduced by a third. The reluctance of coastal operators to invest in modern shipping, further strengthens the Railways position as they have an obligation to ensure that adequate transport facilities are provided.

6.3 South Island Container Port

The unanimous opinion of the Molyneux Report, the British Conference Lines' container investigations, and the Metra Report was that New Zealand's container service should, in the first instance, be limited to two ports, Auckland and Wellington. Their opinions were shared by the Transport Commission and the New Zealand Ports Authority. Emotive and parochial comments abound on this subject and while several ports have spent much effort in assembling evidence purporting

to support their particular claim - to be the South Island container port - the issue remains clouded.

Confusion has stemmed from two separate issues being discussed at once. While some South Island harbour boards have vigorously attacked the location of both container ports in the North Island, on the grounds that this would have disastrous results for the South Island, they are often equally opposed to the suggestion that a South Island container port be located at any port other than their own. An examination of these two issues, the evidence supporting the need for a South Island container port and its desirable location, would form the basis of a complete study in itself. However attention will be focussed on the three reasons most frequently mentioned as supporting the need for a South Island container port.

Internal Transport Costs - Quite detailed studies have compared the costs of moving all the South Island's exports to Wellington with the costs of centralisation at one South Island port. The Otago Harbour Board (1971,7) found that the transport of South Island meat, wool, hides, fruit and cheese would involve an annual transport haul of 193 million ton-miles to Wellington as opposed to a total of 62 million ton-miles to Otago. These findings have been used as evidence supporting the need to construct a South Island container port.

A false assumption made in these calculations is that all South Island produce would be containerised. This was never suggested as advantageous, either by the British Conference

Lines or in the Metra Report. Furthermore it is dangerous to reach conclusions on the merits of particular systems based on a comparison of small portions of each. It is necessary to calculate the operating costs of moving containers through (not just to), a South Island port. A feature of the cellular container system is the very high cost of terminal facilities and therefore, in order to achieve acceptable unit throughput costs, terminal throughput must be very high. A South Island container port would naturally decrease internal transport costs, as well as benefitting the port concerned, but it has not been demonstrated that a sufficient level of cargo throughput could be achieved to lower total system costs. For example it seems certain that container handling charges at Wellington would need to be increased, due to the reduced level of utilisation, and additional costs would be incurred by the container ship operators.

Regional Development - Submissionson this subject have implied that the absence of a container port in the South Island will "...act as a disincentive for further industrial development in the area"(Lyttelton Harbour Board, 1969a), and conversely that "... the establishment of a ... container port would be a practical and painless way now of taking a positive step to help reduce excessive drift to the North" (Otago Harbour Board,1971,9). Unfortunately the way in which a container port would reduce this "excessive drift" is not suggested - though the implication is that industry will be attracted to locate near a container port.

Under the British Conference Lines' original container proposals a provincial shipper using the container service would not have to pay more in total transport because his goods were carried in containers through Auckland or Wellington, instead of being shipped directly through his nearest port. He would be charged no more for internal transport than if he had shipped through his nearest port. Hence the absence of a container port would not have faced South Island shippers with increased freight charges, in comparison with their North Island counterparts. Some time savings may accrue to the shipper located close to a container port.

Both Ogandana(1970) and Forward(1970) consider that along with the tendency for trade to be concentrated through a reduced number of ports there may result a similar concentration of manufacturing. The only empirical study found by the author on this subject was by Johnson and Garnett(1971,202), who after investigating the impact of the introduction of containerisation on British business firms, concluded that "... there is no evidence of firms siting themselves in a locality because of the proximity of a container terminal... It is difficult to see how a Scottish industrialist would suffer in the absence of container terminal in Scotland.". In Chapter IV estimates of the income harbour boards and watersiders may lose should cargo be diverted away from their port were presented. This represents a real loss to the local economy but must be balanced against the savings inherent in the new system. The tendency to assume that large-scale industrial complexes (which are often located adjacent to

ports where deep water and suitable industrial land coincide, will follow the establishment of a container port, is at present unfounded.

Internal Transport Congestion - It is generally assumed that South Island containers will move to and from the container port at Wellington via the rail system. (The choice of mode used to aggregate containers will be discussed in the following section). The Christchurch/Picton railway line passes through some very difficult terrain where slips and derailments are not uncommon. As many submissions have pointed out, there is a danger in relying completely on this one link for the assembly and distribution of all South Island containers. (A schematic outline of the South Island rail system (Figure 17), illustrates the degree to which containers would be concentrated over a single stretch of track. Line sections which need upgrading to accommodate I.S.O. containers on normal deck wagons are shown). The ability of this single-track line to handle the increased tonnages of goods has also been questioned.

The Railways Department have countered these fears by stating that the Christchurch/Picton railway line has ample capacity to meet all future demands. Should an increase in capacity be required there would be many simple means of achieving this (for example, through an increase in locomotive power, increased wagon loadings, etc.). While they concede that severe climatic conditions are regularly experienced around some areas of this track, they feel that they have modern equipment readily available to deal with any disruption.

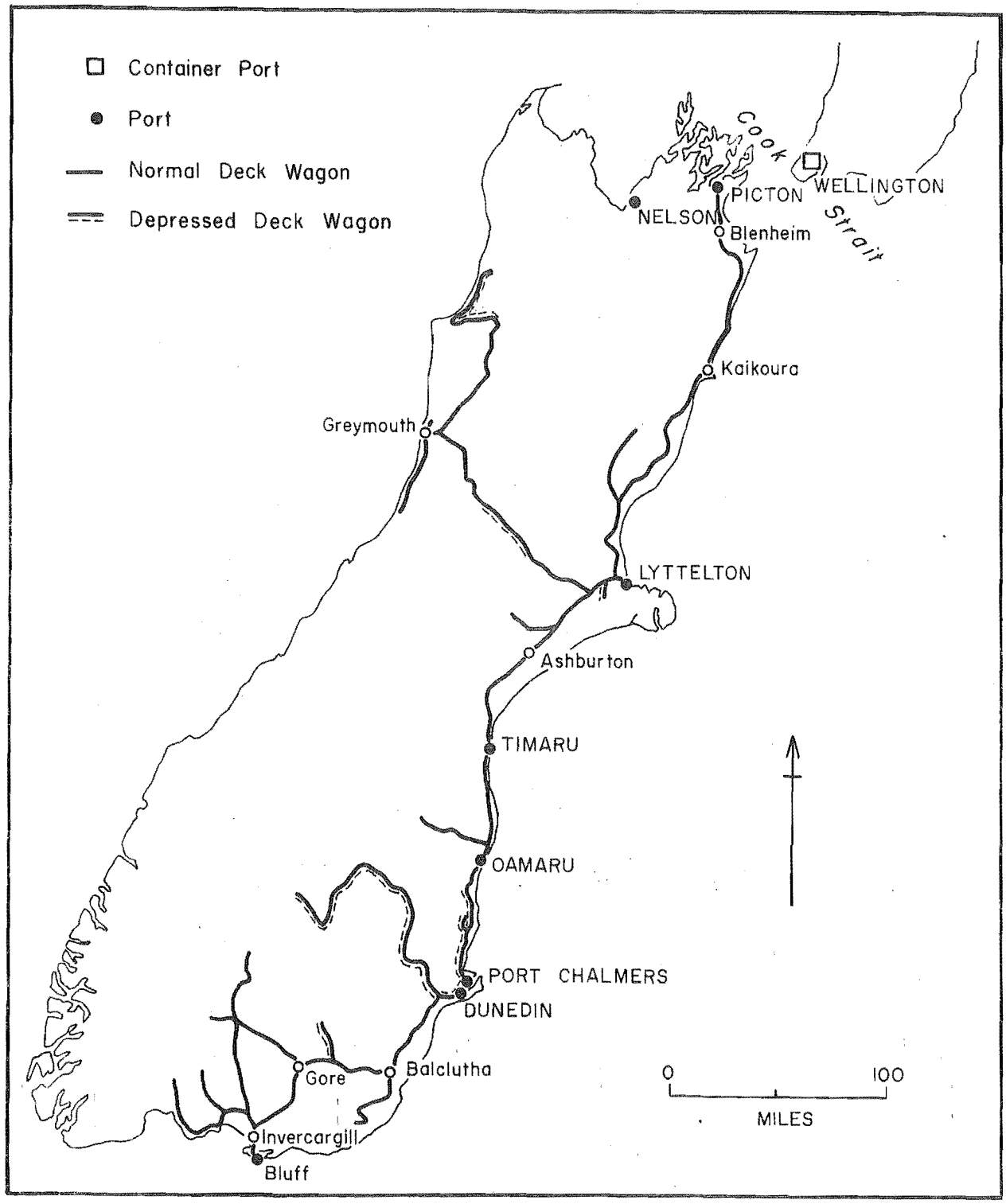


Figure 17 South Island Railway System

Both the Lyttelton and Otago Harbour Boards have published studies showing why they should be the South Island container port. Lyttelton, having already invested large amounts of capital in a bulk handling complex claims it could complete the construction and purchase of facilities necessary to accomodate containers for as little as $1.5 million, and Otago claims that it has the lowest container development costs of any South Island port. The Otago Harbour Board has also assembled data suggesting that the internal freight costs incurred in reaching its port would be less than for any other port. It also feels that the location of Port Chalmers within 250 miles of all South Island freezing works (excluding those at Nelson and Picton), would be to its advantage. This is because the time from the commencement of loading frozen produce into a container to entry into the refrigerated stack of the container terminal (or ship), should not exceed 48 hours. As Haughey(1970,109) has demonstrated, this would exclude Lyttelton as a possible location because under the present rail system it would take at least 48 hours to transport meat from freezing works south of Dunedin to Lyttelton.(10)

Understandable concern has been expressed by some South Island harbour boards who feel their existence might be threatened with the introduction of containerisation. Many submissions have been made stressing the urgent need to locate a container port in the South Island, but no substantive evidence has been presented to show that such a port would reduce the overall cost of transporting New Zealand's overseas

trade. In view of the uncertainty surrounding the type of shipping likely to serve New Zealand in the future (outlined in Chapter IV), investment in a third container port is unwarranted. The continued introduction of containers seems inevitable but there are now more multi-purpose and semi-container ships entering the New Zealand service. Unlike full container ships they can load containers at non-container ports, therefore providing a much more flexible operation.

6.4 Method of Container Aggregation

The impact of containerisation on New Zealand ports will be dependent upon the transport mode selected to move containers to and from the container ports. Some of the possible methods which may be used to move containers are illustrated in Figure 18.

It has frequently been suggested that the aggregation of containers by coastal feeder ships would offer transport savings over other modes, in addition to alleviating the loss suffered by provincial ports under the container system. A former Minister of Marine commented that as export trade will be concentrated at a few ports, it would "... be logical to expect that a larger volume of coastal trade will be handled by non-exporting ports as they clear shipments to and from shipping terminals".(Anon.,1969a). Shipping executives saw coastal feeder ships as a possible means of connecting South Island importers and exporters with the container terminal at Wellington (Anon.,1970e), and many others have felt this system would be both desirable and

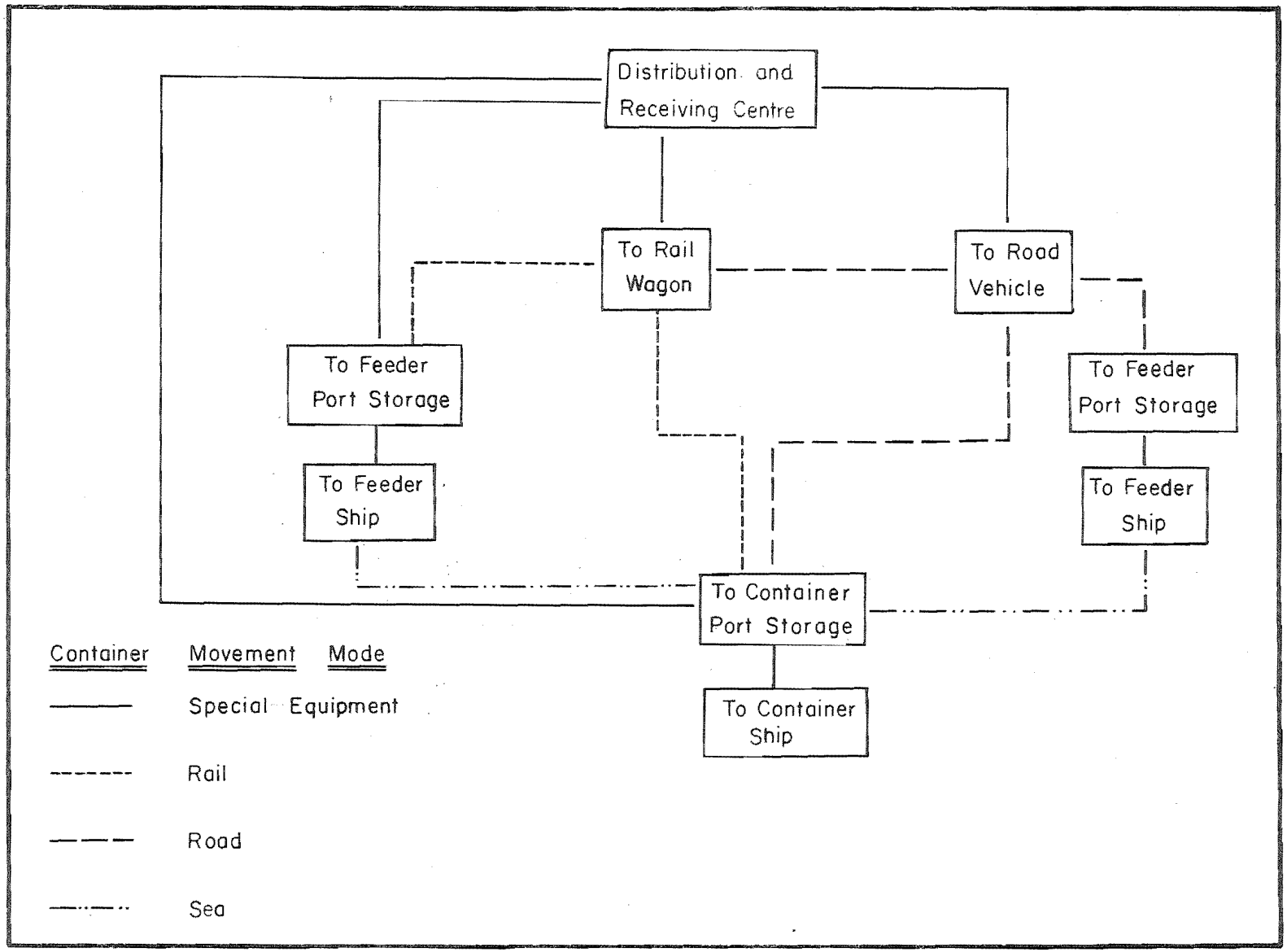


Figure 18 Schematic Representation of Container Aggregation

feasible.(11)

Two main issues are involved in deciding on the mode to be used to transport South Island containers to Wellington: the ability of the railway system to handle the increased traffic, and the relative economics of rail and coastal shipping.

Rail Capacity Restraints - Aronis(1970) has demonstrated that calculating the capacity of a railway system is a very complex task. Although the Railways Department have not indicated what the physical capacity of any particular stretch of track might be, they have stated that increased rail movements within the South Island could easily be handled by existing facilities. During the year ended 31 March 1969 the Morrinsville/Frankton section of railway carried the heaviest density of traffic of any single line section. Traffic densities on various rail sections, together with an index figure to ease comparison are shown in Table 37.

Table 37

DENSITY OF RAIL TRAFFIC
Year Ended 31 March 1969

RAILWAY SECTION	TRAFFIC DENSITY (Gross Tons/Route Mile)	INDEX
Morrinsville/Frankton	3,948	100
North Island	2,085	53
South Island	892	23
Christchurch/Picton	1,252	32

SOURCE: New Zealand Railways Department.

The relatively low traffic density within the South Island is immediately apparent and the Railways Department

feels that much more traffic could be carried on the Christchurch/Picton line simply by running more trains.(12) The maximum number of containers which would have required transport to the South Island under the Conference Lines' container proposal would have been approximately 310 a fortnight. Assuming 50 containers per container train, only an additional six trains a fortnight would have been necessary. With the third Cook Strait rail ferry designed to carry 52 20 foot containers on railway wagons, and 10 20 foot containers on trailer units, the fortnightly potential of this single ferry would approach 1,000 20 foot containers on railway wagons per fortnight.(13)

Rail capacity restraints, either on the Cook Strait ferries or on the Christchurch/Picton line, do not appear likely to hinder the movement of South Island containers to and from Wellington. The disadvantage of concentrating the bulk of the Island's exports and imports over this single line is difficult to quantify, although the potential danger is apparent.

Feasibility of a Coastal Feeder Service - None of the reports which investigated the feasibility of the container system were very specific as to how containers would be transported within New Zealand. The Metra Report, the only study made in New Zealand with access to road, rail and coastal shipping cost data, concluded that "... whilst on some routes coastal container ships can give rise to savings over rail, there does not appear to be a sufficient volume of trade on enough routes to justify their use". (Metra Report,1968,41). Even when a high level of

containerisation was examined, and a container port was situated at an extreme location in the country, Metra found that the load factor on a coastal feeder service did not rise above 40 percent. But Metra did not consider the possibility of carrying containers on the existing roll-on/ roll-off shipping services. Had this been considered a much greater load factor would have resulted.

Several studies have considered the most appropriate type of vessel for a container feeder service. In a comprehensive survey of types of ships in service overseas which might be suitable for the aggregation of containers in New Zealand, Waters(1971,15) decided that "... national container ports should be serviced by small cellular container ships of the "MINHO" and "HUSTLER" types ...", although he did not discuss the cost of operating such vessels. A study by A.D. Little (Inc.) looked specifically at the possibility of instituting waterborne feeder services to move containers to and from major "express" ports. In examining United States North Atlantic ports, assuming New York was the major container port, they found only modest potential for such a service. The extra time and handling cost involved in moving from an inland point to a feeder port, and then by water to the main port, made the system unattractive.

In light of A.D. Little's very detailed study, some comments can be made regarding the feasibility of a New Zealand coastal feeder service:

(i) Shipowners will control the internal movement of containers within New Zealand and in selecting a transport

mode they will only be concerned with the economics of the operation, not the regional implications of their choice. Shipping lines have suggested that while a coastal feeder system may be appropriate for the movement of South Island goods through Wellington, it would be more economical to use rail within the North Island.(14) It is doubtful whether a coastal operator would be prepared to invest in a specialised feeder system for only the South Island trade, especially as there will be continued pressure to locate a container port in the South Island.

(ii) Rail transport has a real advantage over other forms of transport during the introductory phase of containerisation because it enables small numbers of containers to be hauled from different sources without a large increase in operating costs. While the rail system is very large, its individual units are readily adaptable to non-containerised cargoes, and so its load factor may be controlled. In comparison a coastal feeder system consists of a few large transportation units. Ship costs cannot be readily reduced in proportion to cargoes available.(15)

(iii) Much of the South Island's exports require refrigeration. Speed of transport is therefore critical. The stockpiling of containers at feeder ports, necessary to speed ship turnround, would require further investment in refrigerated plant (such as clip-on units). This investment would not be required to the same extent by rail transport. Special container trains are now being run on direct service, without shunting and remarshalling halts, to and from the container ports.

In view of the uncertainty surrounding the introduction of containers into the New Zealand trade, combined with the heavy investment made by the Railways in container movement facilities and the pressure from some quarters for the establishment of a third container port in New Zealand, it is unlikely that a shipping operator would purchase a vessel specifically for a coastal feeder service. Although some containers may be moved by the existing coastal fleet it seems certain that only a small proportion will be handled by this mode. While the Railways have stressed that "as a matter of national interest full use must be made of existing transport facilities to ensure that capital investment is not wasted", exactly the same reasoning may be offered by harbour boards to promote the continued use of their facilities. This point serves to illustrate the real need for effective control to be exercised over all sectors of the transport industry.

Footnotes

(1) The ports at Greymouth and Westport are excluded.

(2) This Table is derived from Appendix XXVII. Motor vehicles are each assumed to represent five manifest tons, and one deadweight ton is taken as equalling 1.6 manifest tons. (This ratio was derived by averaging the ratio between manifest and deadweight tons over the three years 1968 to 1970).

(3) In addition, bulk coal shipped from Westport and Greymouth, and bulk cement shipped from Portland, Tarakohe and Westport must be added.

(4) For example, see the statement by the Minister of Transport (Hansard,1969,1330): "I wish to quote some figures which I think will prove that coastal shipping has not suffered from the modernising and the efficiency of the railway system". The Minister then compared tonnages moved by coastal shipping in 1957 with comparable tonnages for 1969 (excluding certain bulk products). But while the total coastal trade did increase over this period, since 1964 inter-island trade carried by conventional shipping has remained virtually static.

(5) The tonnages carried by conventional coastal shipping services are listed in Appendix XXVIII.

(6) A large number of submissions presented to the Commission of Inquiry into New Zealand Shipping dealt with this subject.

(7) The third ferry, the "Arahanga" entered service late in 1972 while the fourth ferry designed almost wholely for the carriage of freight is due for delivery in April 1974.

It has been reported that since August 1972 the Railways Department's weekly capacity for shipping rail waggons across Cook Strait has more than doubled - from 630 waggons each way to 1,300 each way (The Press, 12 December 1972).

In August 1972 the ferry timetable was rearranged to increase the 21 sailings a week to 25. This meant that waggon capacity rose to 750 each way a week. With the advent of the "Arahanga" which is primarily a freight vessel, the capacity of the ferry service was increased to 1,300 rail waggons each way a week.

(8) Here it is surprising that in reaching their decision regarding the ordering of the fourth Cook Strait ferry, the Transport Advisory Council did not request that a forecast be made of total inter-island traffic.

(9) During the Commission of Inquiry into New Zealand Shipping the commercial manager, New Zealand Railways was asked:

> "In effect, your policy is that once the traffic goes by rail you do your best to ensure that it always goes by rail by regulating your charges as necessary? ... Yes".

The ability of the Railways to compete is further bolstered by their receiving loans at very low interest rates. For example it is noted in the Report of the Railways Department(1972) that:

> "It is Government's policy that railways should operate on a commerical basis in the long term but because of the short-term financial problems facing railways, finance by way of interest-free loans is being provided in order to permit the department to carry on its day-to-day operations and to continue with the planned development programme.".

(10) This factor has now been removed as with the increase in container traffic special container trains are being run on direct service without shunting and remarshalling halts to and from the container ports. For example, New Zealand's first long-distance container crane left Invercargill at 7.p.m. and the containers had been unloaded at the Wellington Container Terminal by 7.30.a.m. the following morning.

(11) The Northland Harbour Board(1969), stressed the dire regional consequences which would result if such a service was not introduced, but while claiming that this service would offer transport savings, felt that a form of protection would be necessary. King (1971,107) considered that it would be feasible to run a small container ship on a coastal feeder service, but as is common with much literature on this subject did not progress further than raising the possibility.

(12) The capacity of the line could further be improved by the introduction of special container trains, the easement of grades and curves, improved signalling systems or by increasing locomotive power.

(13) The exact potential would depend on the scheduling of sailings.

(14) The costs to shipping lines of aggregating containers using the alternative modes could be determined by using the network method demonstrated in Chapter V.

(15) A.D. Little's study estimated that the fixed costs of feeder ships formed over 80 percent of the service's total annual costs.

CHAPTER VII

CONCLUSIONS

Within New Zealand there is general agreement that some form of transport planning is necessary. While this need is appreciated, and some broad transport objectives have been formulated, much uncertainty surrounds the degree to which recent transport proposals within the shipping industry will in fact satisfy these objectives.

The approach commonly adopted towards transport planning in New Zealand corresponds to what Burns(1969) has termed the "bottleneck" approach. Comprehensive planning requires that future activities be predicted in both time and space. The bottleneck approach removes this necessity since the time is the present and the place is the physical location of the bottleneck. Under this system planners concentrate on removing obvious bottlenecks to the efficient movement of goods, and make marginal improvements to certain transport policies and regulations. Although there are many organisations within New Zealand to identify and correct these bottlenecks, a big deficiency in this approach is that there is often a long period between the perception of a bottleneck and the implementation of a corrective solution.

This study demonstrates an approach whereby transport planners may progress from a bottleneck-type approach, to a position where the system-wide repercussions of alternative projects may be incorporated in the decision-making process.

7.1 Summary

Rapid changes in shipping technology are placing ports in an uncertain position. New facilities are required to accommo-

date modern container and unit-load vessels, and should these not be provided a port may see its traditional cargo diverted elsewhere. But in constructing these very expensive facilities, often with little or no guarantee that they will be fully utilised, ports run the risk of losing financial stability. Port investment decisions must be co-ordinated on a national basis, and made with an awareness of likely developments not only within the shipping industry but also within internal transport systems.

With the rapid development of unit-load cargo handling methods there will be increased pressure to concentrate cargoes through a reduced number of ports. As well as altering the physical nature of ports, these developments will have widespread implications for the overall spatial development of a country's port system.

The New Zealand Ports Authority was set up in 1968 to co-ordinate investment in New Zealand's ports, but as yet has not brought down its national plan. In evaluating alternative container shipping proposals the Ports Authority acknowledged the likelihood that their introduction may threaten the economic viability of some New Zealand ports. But the Government made no examination of internal ramifications in approving of the container principle; indeed the Metra Report, which greatly influenced the Government's decision, stressed that the sole criterion they used to determine the transport system most advantageous to New Zealand's economy was that of transport cost. No account was taken of other considerations which may be relevant to the choice of a transport system.

This study calculated the economic impact, in terms of income and employment generated, of the ports at Nelson, Picton, Lyttelton, Timaru, Oamaru, Dunedin and Bluff. During the 1969/70 financial year these ports injected over $5 million into their local communities, and when waterside workers' incomes and port capital expenditure are included this value increases to over $14 million. Employment as waterside workers or harbour board employees for 2,667 people were provided at these seven ports.

A series of regional multipliers were derived to allow the total impact of these ports to be assessed. Applying the relevant multipliers to the initial expenditure injected, it was estimated that these ports generated revenue between $16 million and $19.5 million during 1969/70. This generated revenue was calculated to provide employment for at least 7,786 people.

Revenue coefficients, indicating the revenue each port received from handling particular trades and commodities, were calculated. Coefficients for general cargo, which is handled by break-bulk methods, were much greater than for dry and liquid bulk cargoes, which are handled mechanically. For example the movement of one ton of general cargo through Timaru was found to generate $4.24 in harbour board revenue, whereas the revenue generated in handling one ton of dry bulk cargo at Nelson was only $0.61.

These coefficients enabled various cargo aggregation proposals to be evaluated in terms of their financial implications to ports. The suggested concentration of the

South Island's East Coast North America trade through the container port at Wellington, was shown to reduce the South Island harbour boards' revenue by over $240,000 per annum. Generated revenue removed from the local economies would exceed $465,000.

A transport model, based on network analysis methods, was formulated to enable the internal transport costs of a number of cargo aggregation schemes to be determined. Alternative meat and wool distribution policies were modelled to estimate their associated transport costs.

Internal transport costs incurred in shipping wool exports through only one South Island port (Otago) were shown as being $4,267,513, and the cheapest two-port combination (Timaru/Bluff) would cost $3,616,094. Should the South Island's meat exports be aggregated at only one port, Bluff - despite its relatively isolated location - would be the most favourable port. Under a two-port meat loading scheme the Timaru/Bluff combination would offer slight internal transport savings over Lyttelton/Bluff. The system-wide implications of such distribution policies were assessed.

The future role to be played by New Zealand's coastal shipping industry is uncertain. Sharp inroads into the traffic traditionally carried by coastal shipping operators have been made by the Cook Strait rail ferries. A situation has been reached where coastal operators are reluctant to invest in the modern shipping they realise is required for the New Zealand coastal trade, because of the Railways concentration on long-haul inter-island movements.

The feasibility of a coastal container feeder service was examined, as it has frequently been suggested that such a service would offer transport savings (over road and rail), in addition to alleviating the loss suffered by provincial ports under the container system. In view of the uncertainty surrounding the introduction of containers into the New Zealand trade, combined with the heavy investment made by the Railways Department in container facilities, it is considered that a coastal feeder service would not be an economically viable proposition.

Future developments within New Zealand's port system will be largely determined by the type of shipping which emerges as best suited to the country's trading requirements, although there is the possibility that the Government may increasingly take into consideration a wider range of factors when evaluating shipping proposals. General cargo will tend to be handled by unitised methods, although the concentration of this trade through Auckland and Wellington might not be as great as has been predicted. Many provincial ports will in the future be called upon to handle predominantly bulk cargoes.

Port investment decisions should not be reached without an awareness of developments accruing within all transport modes. Of paramount importance is the need to formulate a series of policies to co-ordinate the use and development of all components of New Zealand's transport system, so that the resources devoted to transport are channelled into the most productive areas. In formulating such policy, it is vital that objective studies be made of the total costs incurred within each transport mode in performing certain tasks. Without such studies it is impossible for New Zealand to formulate a rational transport policy.

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The very large number of groups and organisations directly involved in the transportation of New Zealand's produce - either in constructing, maintaining and administering the necessary facilities, or in operating the services - means that any detailed research in this broad field would be impossible without the co-operation of a great many people. Through such co-operation I was fortunate to be given access to much unpublished and confidential data, which in turn formed the bulk of the study's basic material. I wish to thank the numerous bodies and individuals who contributed in this way. Without their assistance the study could not have been tackled.

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D-2 Railways Department

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New Zealand Meat Producers Board

New Zealand Wool Board

Submissions Made to Royal Commission to Inquire into and Report Upon Handling of Containers, Seafreighters, and Unitised Cargo

Submissions Made to the Commission of Inquiry into New Zealand Shipping.

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Christchurch Star	Christchurch
Dominion	Wellington
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New Zealand Herald	Auckland
Northern Advocate	Whangarei
Otago Daily Times	Dunedin
Press	Christchurch
Southland Times	Invercargill
Timaru Herald	Timaru

Appendix I

EMPLOYMENT BY INDUSTRIAL GROUPS : BLENHEIM

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	54	74	65	64	60	75	84	71	88
Seasonal Manufacturing	235	203	210	204	226	227	302	284	286
Food, Drink, Tobacco	86	91	97	103	115	92	121	124	111
Textiles, Clothing Leather	185	217	204	188	210	237	182	201	221
Building Materials	138	162	161	155	148	144	142	136	138
Engineering, Metal	412	428	432	470	529	547	540	577	606
Miscellaneous Manufacturing	159	162	161	167	173	179	173	177	182
Power, Water, Sanitary Services	183	220	191	131	136	131	149	149	144
Building, Construction	749	743	736	729	794	848	853	832	816
Transport, Communication	848	835	864	892	943	929	959	976	1,009
Commerce, Wool and Grain Stores	961	1,007	1,007	1,014	1,078	1,061	1,046	1,053	1,075
Domestic and Personal Services	254	276	261	273	290	288	301	330	364
Administration, Professional	911	953	969	986	1,038	1,081	1,085	1,069	1,112
TOTAL	5,175	5,371	5,358	5,376	5,740	5,839	5,937	5,979	6,152

SOURCE: Prices, Wages, Labour, 1962/1970: Department of Statistics, Wellington.

Appendix II

EMPLOYMENT BY INDUSTRIAL GROUPS: CHRISTCHURCH

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	532	547	578	596	566	726	728	712	603
Seasonal Manufacturing	2,009	2,025	2,398	2,305	2,349	2,387	2,457	2,676	2,644
Food, Drink, Tobacco	2,192	2,260	2,345	2,324	2,343	2,454	2,485	2,508	2,520
Textiles, Clothing Leather	7,883	8,000	8,294	8,330	8,406	7,745	7,734	8,471	8,598
Building Materials	3,450	3,562	3,834	4,062	4,180	3,962	3,953	4,272	4,288
Engineering, Metal	10,825	11,496	11,802	12,416	13,076	12,675	12,532	13,238	14,241
Miscellaneous Manufacturing	4,880	5,081	5,035	5,330	5,701	5,383	5,584	5,881	5,938
Power, Water, Sanitary Services	2,260	2,300	2,282	2,255	2,243	2,344	2,450	2,378	2,529
Building, Construction	5,873	6,064	6,508	6,779	6,595	6,086	5,629	5,674	5,915
Transport, Communication	7,997	7,925	8,141	8,301	8,381	8,449	8,349	8,268	8,693
Commerce, Wool and Grain Stores	15,281	15,868	16,488	16,853	16,985	16,989	16,880	16,868	16,899
Domestic and Personal Services	3,373	3,440	3,473	3,603	3,490	3,563	3,564	3,634	4,030
Administration, Professional	13,456	13,840	14,548	14,990	15,628	16,479	17,035	17,639	18,740
TOTAL	80,011	82,408	85,726	88,144	89,943	89,242	89,380	92,220	95,638

SOURCE: Prices, Wages, Labour, 1962/1970. Department of Statistics, Wellington.

Appendix III

EMPLOYMENT BY INDUSTRIAL GROUPS: TIMARU

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	14	12	9	16	14	16	18	17	23
Seasonal Manufacturing	440	457	425	453	467	504	569	574	598
Food, Drink, Tobacco	318	321	321	293	280	283	283	268	272
Textiles, Clothing Leather	621	665	735	779	830	744	702	780	841
Building Materials	468	487	553	519	564	480	457	491	473
Engineering, Metal	731	765	839	901	910	894	890	933	944
Miscellaneous Manufacturing	153	155	167	186	187	208	188	194	200
Power, Water, Sanitary Services	210	214	218	204	198	196	206	222	253
Building, Construction	947	937	958	983	1,025	954	882	1,034	1,545
Transport, Communication	1,309	1,324	1,394	1,391	1,442	1,331	1,303	1,271	1,295
Commerce, Wool and Grain Stores	2,467	2,478	2,592	2,685	2,698	2,636	2,584	2,600	2,521
Domestic And Personal Services	654	678	705	691	712	697	758	709	711
Administration, Professional	1,894	1,942	1,998	2,103	2,148	2,171	2,225	2,140	2,113
TOTAL	10,226	10,435	10,914	11,204	11,475	11,114	11,065	11,233	11,789

SOURCE: Prices, Wages, Labour, 1962/1970. Department of Statistics, Wellington.

Appendix IV

EMPLOYMENT BY INDUSTRIAL GROUPS: OAMARU

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	36	35	33	37	27	48	36	34	25
Seasonal Manufacturing	184	186	184	198	201	192	234	277	276
Food, Drink, Tobacco	212	218	205	209	209	211	206	202	209
Textiles, Clothing Leather	411	470	433	394	441	419	305	459	447
Building Materials	126	148	149	146	143	136	134	152	142
Engineering, Metal	364	361	391	406	404	379	377	352	360
Miscellaneous Manufacturing	43	39	38	43	43	44	38	41	41
Power, Water, Sanitary Services	241	286	355	298	274	270	269	264	249
Building, Construction	1,443	1,786	1,878	1,585	1,543	1,413	934	1,061	768
Transport Communication	587	590	611	624	639	613	556	579	571
Commerce, Wool and Grain Stores	786	863	874	895	871	871	842	856	814
Domestic and Personal Services	197	224	241	278	286	262	256	253	250
Administration, Professional	781	789	819	813	825	823	843	856	843
TOTAL	5,411	5,995	6,211	5,926	5,906	5,711	5,030	5,386	4,995

SOURCE: Prices, Wages, Labour, 1962/1970. Department of Statistics, Wellington.

Appendix V

EMPLOYMENT BY INDUSTRIAL GROUPS: DUNEDIN

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	534	483	553	530	549	650	747	663	580
Seasonal Manufacturing	755	806	745	800	812	859	856	810	806
Food, Drink, Tobacco	1,608	1,708	1,722	1,822	1,807	1,853	1,932	1,930	1,944
Textiles, Clothing Leather	3,449	3,470	3,520	3,661	3,548	3,225	2,904	3,036	3,083
Building Materials	1,255	1,205	1,255	1,196	1,239	1,191	1,143	1,191	1,163
Engineering, Metal	4,301	4,422	4,651	4,908	4,928	4,851	4,762	4,890	5,091
Miscellaneous Manufacturing	1,676	1,664	1,734	1,725	1,769	1,710	1,768	1,827	1,858
Power, Water, Sanitary Services	937	938	928	965	964	965	983	995	1,003
Building, Construction	3,603	3,657	3,740	3,627	3,724	3,903	3,694	3,353	3,684
Transport, Communication	4,556	4,521	4,489	4,458	4,433	4,392	4,254	4,226	4,386
Commerce, Wool and Grain Stores	7,651	7,717	7,987	7,983	7,887	7,772	7,846	7,862	7,846
Domestic and Personal Services	1,776	1,832	1,906	1,994	2,033	2,062	2,164	2,188	2,147
Administration, Professional	7,915	8,240	8,398	8,644	9,065	9,469	9,417	9,700	10,120
TOTAL	40,016	40,663	41,632	42,213	42,758	42,902	42,470	42,671	43,711

SOURCE: Prices, Wages, Labour, 1962/1970. Department of Statistics, Wellington.

Appendix VI

EMPLOYMENT BY INDUSTRIAL GROUPS: INVERCARGILL

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	636	595	637	630	647	710	678	717	671
Seasonal Manufacturing	1,365	1,469	1,343	1,320	1,350	1,373	1,367	1,379	1,501
Food, Drink, Tobacco	320	336	325	351	349	332	296	318	315
Textiles, Clothing Leather	241	247	242	228	230	227	246	263	285
Building Materials	986	974	1,010	966	974	893	852	926	983
Engineering, Metal	1,785	1,833	1,993	2,181	2,248	2,199	2,149	2,264	2,339
Miscellaneous Manufacturing	680	713	753	828	850	819	781	796	813
Power, Water, Sanitary Services	637	585	565	563	590	685	734	741	777
Building, Construction	1,678	1,949	2,483	2,692	3,378	3,403	3,492	2,612	2,363
Transport, Communcation	2,490	2,455	2,462	2,487	2,522	2,454	2,486	2,456	2,486
Commerce, Wool and Grain Stores	4,430	4,470	4,582	4,627	4,792	4,698	4,621	4,736	4,696
Domestic and Personal Services	905	1,004	1,019	1,167	1,185	1,212	1,397	1,360	1,375
Administration, Professional	3,228	3,396	3,478	3,602	3,569	3,718	3,686	3,762	3,964
TOTAL	19,381	20,026	20,892	21,642	22,684	22,723	22,785	22,330	22,568

SOURCE: Prices, Wages, Labour. 1962/1970. Department of Statistics, Wellington.

Appendix VII

EMPLOYMENT BY INDUSTRIAL GROUPS: NEW ZEALAND

1962/1970

INDUSTRIAL GROUP	EMPLOYMENT								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	10,940	11,345	11,381	11,531	11,480	12,410	13,054	12,578	11,654
Seasonal Manufacturing	22,934	22,985	23,126	23,427	24,612	25,273	26,172	27,143	28,295
Food, Drink, Tobacco	15,228	15,737	15,580	16,162	16,571	16,493	16,545	16,711	17,252
Textiles, Clothing Leather	38,593	40,250	41,201	42,520	43,319	41,429	39,998	43,963	45,046
Building Materials	28,374	29,275	31,062	32,175	32,881	30,662	31,595	33,346	34,254
Engineering, Metal	70,110	75,842	80,562	85,617	89,528	86,820	86,272	91,192	97,536
Miscellaneous Manufacturing	33,819	35,996	37,796	40,436	42,470	41,899	42,264	44,783	46,831
Power, Water, Sanitary Services	13,441	13,689	14,022	13,974	14,376	15,026	15,320	15,324	15,813
Building, Construction	55,351	56,940	59,516	63,248	64,380	61,813	59,068	59,110	61,276
Transport, Communication	68,456	68,639	70,317	71,755	73,664	73,328	73,278	72,991	76,055
Commerce, Wool and Grain Stores	120,314	124,550	129,289	133,785	137,108	137,812	138,650	140,987	142,859
Domestic and Personal Services	27,038	28,109	28,775	29,993	30,694	30,929	31,853	32,275	33,211
Administration, Professional	110,043	114,572	119,561	125,143	131,950	135,934	138,822	144,393	148,015
TOTAL	614,641	637,929	662,188	689,766	713,033	709,828	712,891	734,796	758,087

SOURCE: Prices, Wages, Labour, 1962/1970. Department of Statistics, Wellington.

Appendix VIII

SPECIALISATION RATIOS: BLENHEIM

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Seasonal Manufacturing	0.1764	0.0475	0.1070	0.1040	0.1212	0.0843	0.2766	0.2328	0.1955
Food, Drink, Tobacco	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Textiles, Clothing Leather	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Building Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Engineering, Metal	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.3770	0.4727	0.4031	0.1679	0.1544	0.0610	0.1477	0.1745	0.1111
Transport, Communication	0.3752	0.3526	0.3438	0.3210	0.3451	0.3974	0.4197	0.4279	0.3885
Commerce, Wool and Grain Stores	0.3184	0.3054	0.3391	0.3711	0.3680	0.3477	0.3608	0.3975	0.3855
Commerce, Wool and Grain Stores	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Domestic and Personal Services	0.1063	0.1449	0.1004	0.1465	0.1483	0.1181	0.1196	0.2382	0.2582
Administration, Professional	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix IX

SPECIALISATION RATIOS: CHRISTCHURCH

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Seasonal Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Food, Drink, Tobacco	0.0839	0.0885	0.1228	0.0977	0.0943	0.1165	0.1477	0.1471	0.1198
Textiles, Clothing Leather	0.3211	0.3099	0.2906	0.3080	0.3110	0.2730	0.3124	0.3524	0.2867
Building Materials	0.0000	0.0000	0.0000	0.0000	0.0060	0.0000	0.0000	0.0178	0.0000
Engineering, Metal	0.1389	0.1313	0.1001	0.1055	0.1210	0.1009	0.1214	0.1202	0.1209
Power, Water, Sanitary Services	0.0869	0.0756	0.0244	0.0278	0.0535	0.0000	0.0460	0.0371	0.0064
Building Construction	0.2000	0.2048	0.1814	0.1831	0.1703	0.1510	0.1939	0.1703	0.1870
Transport, Communication	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Commerce, Wool and Grain Stores	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Domestic and Personal Services	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Administration, Professional	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0033

Appendix X

SPECIALISATION RATIOS: TIMARU

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Seasonal Manufacturing	0.1318	0.1751	0.1035	0.1567	0.1499	0.2123	0.2830	0.2735	0.2609
Food, Drink, Tobacco	0.2013	0.1963	0.1994	0.1024	0.0464	0.0883	0.0954	0.0448	0.0822
Textiles, Clothing, Leather	0.0000	0.0105	0.0762	0.1117	0.1590	0.1263	0.1154	0.1372	0.0540
Building Materials	0.0000	0.0185	0.0741	0.0000	0.0603	0.0000	0.0000	0.0000	0.0000
Engineering, Metail	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0316
Building, Construction	0.0275	0.0064	0.0000	0.0000	0.0000	0.0000	0.0000	0.1248	0.3780
Transport, Communication	0.1283	0.1503	0.1664	0.1603	0.1755	0.1352	0.1259	0.1212	0.0857
Commerce, Wool and Grain Stores	0.1857	0.1751	0.1763	0.1877	0.1794	0.1787	0.1649	0.1685	0.1174
Domestic and Personal Services	0.3073	0.3171	0.3220	0.2909	0.3034	0.3013	0.3443	0.3005	0.2700
Administration, Professional	0.0333	0.0345	0.0184	0.0333	0.0112	0.0193	0.0315	0.0000	0.0000

Appendix XI

SPECIALISATION RATIOS: OAMARU

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Seasonal Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2992	0.2816	0.3261
Food, Drink, Tobacco	0.3679	0.3211	0.2878	0.3349	0.3445	0.3697	0.4320	0.3960	0.4545
Textiles, Clothing Leather	0.1727	0.1957	0.1085	0.0736	0.1859	0.2052	0.0754	0.2963	0.3356
Building Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Engineering, Metail	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.5062	0.4545	0.6254	0.5940	0.5620	0.5481	0.5948	0.5720	0.5823
Building, Construction	0.8294	0.6943	0.6965	0.6517	0.6494	0.6433	0.5503	0.5881	0.4714
Transport, Communication	0.0000	0.0000	0.0000	0.0128	0.0454	0.0392	0.0701	0.0760	0.1226
Commerce, Wool and Grain Stores	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Domestic and Personal Services	0.0000	0.0000	0.0000	0.0755	0.1119	0.0534	0.0469	0.0672	0.1280
Administration, Professional	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix XII

SPECIALISATION RATIOS: DUNEDIN

1962/1970

INDUSTRIAL GROUP	SPECIALISATION RATIOS								
	1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Seasonal Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Food, Drink, Tobacco	0.3607	0.3882	0.4053	0.4304	0.4250	0.4355	0.4617	0.4694	0.4630
Textiles, Clothing Leather	0.2551	0.2455	0.2491	0.2726	0.2531	0.2081	0.1694	0.1499	0.1495
Building Materials	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Engineering, Metal	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.0608	0.0640	0.0496	0.1078	0.1006	0.0580	0.0671	0.0995	0.0857
Building, Construction	0.0000	0.0071	0.0000	0.0000	0.0000	0.0405	0.0447	0.0000	0.0391
Transport, Communication	0.0209	0.0305	0.0143	0.0144	0.0038	0.0000	0.0000	0.0000	0.0005
Commerce, Wool and Grain Stores	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Domestic and Personal Services	0.0090	0.0759	0.0447	0.0752	0.0895	0.0887	0.1169	0.1362	0.1025
Administration, Professional	0.0891	0.1068	0.0988	0.1076	0.1199	0.1247	0.1152	0.1281	0.1483

Appendix XIII

SPECIALISATION RATIOS: INVERCARGILL

1962/1970

INDUSTRIAL GROUP	SPECILISATION RATIOS 1962	1963	1964	1965	1966	1967	1968	1969	1970
Forestry, Mining	0.4434	0.3916	0.4097	0.4127	0.4219	0.4282	0.3717	0.4519	0.4694
Seasonal Manufacturing	0.4564	0.4935	0.4460	0.4295	0.4074	0.3977	0.3767	0.3901	0.4257
Food, Drink, Tobacco	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Textiles, Clothing Leather	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Building Materials	0.0903	0.0544	0.0210	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Engineering, Metal	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Miscellaneous Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Power, Water, Sanitary Services	0.3325	0.2581	0.2088	0.2167	0.2203	0.2905	0.3243	0.3617	0.3822
Building, Construction	0.0000	0.0806	0.2364	0.2548	0.3816	0.4058	0.4456	0.3036	0.2277
Transport, Communication	0.1293	0.1185	0.0967	0.0917	0.0694	0.0428	0.0563	0.0945	0.0869
Commerce, Wool and Grain Stores	0.1391	0.1215	0.1065	0.0899	0.0870	0.0594	0.0400	0.0925	0.0918
Domestic and Personal Services	0.0564	0.1185	0.1070	0.1885	0.1713	0.1774	0.2634	0.2713	0.2735
Administration, Professional	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix XIV

REVENUE RECEIVED BY TRADE AND CARGO FORM : PICTON

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo dollars/ton)
Overseas - General	18	18,569	26,832	1,490	1.445
Overseas - Logs	3	5,295	5,041	1,680	0.952
Coastal - General	8	7,014	4,527	565	0.645
Cook Strait Ferry (2)	219	320,916	120,118	548	0.374

(1) Total Shipping Arrivals - 1,028. (Cook Strait Ferry Arrivals - 994).

(2) Information on these ferries was in the form of Weekly Summaries of Wharfage. A sample covering 12 weeks was taken. Pilotage and port charges are payable every six months and an estimate of the weekly component was made.

SOURCE: Calculated from information obtained from the Marlborough Harbour Board.

Appendix XV

REVENUE RECEIVED BY TRADE AND CARGO FORM : NELSON

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Overseas - General	46	119,180	213,411	4,639	1.790
Overseas - Wood Chips	8	136,087	78,973	9,871	0.580
Overseas - Logs	21	150,399	162,166	7,722	1.078
Overseas - Fruit	9	52,993	86,347	9,594	1.629
Overseas - Dry Bulk	4	5,475	7,128	1,782	1.302
Coastal - Liquid Bulk	12	76,185	75,739	6,311	0.994
Coastal - General	40	8,482	12,262	306	1.446

(1) Total Shipping Arrivals - 390.

SOURCE: Calculated from information obtained from the Nelson Harbour Board.

Appendix XVI

REVENUE RECEIVED BY TRADE AND CARGO FORM : LYTTELTON

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Overseas - General	153	183,010	150,757	2,982	2.493
Overseas - Dry Bulk	4	36,472	49,672	12,418	1.362
Coastal - General	42	33,719	53,646	1,277	1.591
Coastal - Dry Bulk	5	6,081	4,164	833	0.685
Coastal - Liquid Bulk	4	34,219	37,709	9,427	1.102
Roll-on/Roll-off (2)	-	-	-	-	-

(1) Total Shipping Arrivals - 1,024 (Excluding roll-on/roll-off ships - 568).

(2) Not obtainable.

SOURCE: Calculated from information obtained from the Lyttelton Harbour Board.

Appendix XVII

REVENUE RECEIVED BY TRADE AND CARGO FROM : TIMARU

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Overseas - General	54	51,450	202,965	3,758	3.945
Overseas - Meat Loaders	25	86,817	408,842	16,353	4.709
Overseas - Dry Bulk	3	32,981	25,074	8,358	0.760
Coastal - General	24	8,777	18,165	756	2.070
Coastal - Dry Bulk	8	9,796	7,352	919	0.751
Coastal - Liquid Bulk	3	19,023	18,547	6,182	0.975

(1) Total Shipping Arrivals - 223.

SOURCE: Calculated from information obtained from the Timaru Harbour Board.

Appendix XVIII

REVENUE RECEIVED BY TRADE AND CARGO FORM : OAMARU

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Coastal - General	57	14,988	16,516	289	1.102
Coastal - Dry Bulk	4	2,948	1,786	446	0.606

(1) Total Shipping Arrivals - 72.

SOURCE: Calculated from information obtained from Oamaru Harbour Board.

Appendix XIX

REVENUE RECEIVED BY TRADE AND CARGO FORM : OTAGO

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE(1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Overseas - General	72	73,066	197,571	2,744	2.704
Overseas - Logs	7	43,351	47,938	6,848	1.105
Overseas - Dry Bulk	4	19,190	25,345	6,336	1.320
Coastal - General	29	17,622	35,785	1,234	2.030
Coastal - Dry Bulk	1	1,557	2,599	2,599	1.669
Coastal - Liquid Bulk	6	48,814	71,659	11,943	1.468
Roll-on/roll-off	10	25,306	28,143	2,814	1.112

(1) Total Shipping Arrivals - 371.

SOURCE: Calculated from information obtained from the Otago Harbour Board.

Appendix XX

REVENUE RECEIVED BY TRADE AND CARGO FORM : BLUFF

Year Ended 30 September 1970

TRADE AND CARGO FORM	SHIPS IN SAMPLE (1)	TOTAL CARGO (tons)	TOTAL REVENUE (dollars)	REVENUE RECEIVED	
				Ship (dollars/ship)	Cargo (dollars/ton)
Overseas - General	77	146,757	593,315	7,705	4.042
Overseas - Dry Bulk	11	113,507	107,036	9,730	0.943
Overseas - Tiwai Smelter	3	14,029	6,127	2,042	0.436
Coastal - General	30	24,650	39,316	1,310	1.595
Coastal - Dry Bulk	8	12,070	17,859	2,232	1.479
Coastal - Liquid Bulk	5	27,283	25,839	5,167	0.947

(1) Total Shipping Arrivals (excluding Stewart Island Ferry) - 294.

SOURCE: Calculated from information obtained from the Southland Harbour Board.

Appendix XXI

AVERAGE WOOL PRODUCTION ON A COUNTY BASIS, 1967-1970

COUNTY	SHEEP NUMBERS 1967/68	SHEEP NUMBERS 1968/69	SHEEP NUMBERS 1969/70	AVERAGE NUMBERS 1967/70	PRODUCTION ESTIMATES Wool (1) (lbs.)	PRODUCTION ESTIMATES Wool (2) (Bales)
Marlborough	769,865	788,198	769,113	775,725	8,843,265	25,715
Awatere	353,074	361,505	360,035	358,205	4,083,537	11,874
Kaikoura	259,416	254,983	263,309	259,236	2,955,290	8,593
Waimea	560,354	571,168	568,122	566,648	6,458,547	18,781
Golden Bay	105,128	94,969	89,097	96,398	1,098,937	3,196
	19,034	14,338	17,093	16,822	191,770	558
Inangahua	63,737	74,274	71,097	69,703	794,614	2,311
Westland	211,206	209,121	209,750	210,026	2,394,296	6,962
Amuri	574,296	576,009	560,881	570,395	6,502,503	18,908
Cheviot	334,994	339,510	328,487	334,330	3,811,362	11,083
Waipara	722,535	746,352	715,882	728,256	8,302,118	24,141
Ashley	345,929	354,741	347,229	349,299	3,982,009	11,579
Rangiora	116,984	112,340	107,019	112,114	1,278,099	3,716
Eyre	170,406	160,659	151,158	160,741	1,832,447	5,328
Oxford	243,068	237,480	242,383	240,977	2,747,138	7,988
Malvern	823,530	819,269	786,564	809,788	9,231,583	26,844
Paparua	183,729	153,792	145,107	160,876	1,833,986	5,333
Waimairi	4,685	4,658	5,253	4,865	55,461	161
Heathcote	13,505	8,451	11,271	11,076	126,266	367
Mount Herbert	57,205	55,456	58,346	57,002	649,823	1,889
Akaroa	159,921	156,191	152,399	156,170	1,780,338	5,177
Wairewa	109,578	103,637	105,351	106,189	1,210,555	3,520
Ellesmere	451,008	444,488	428,598	441,365	5,031,561	14,631
Ashburton	2,558,616	2,514,900	2,515,669	2,529,728	29,218,358	84,962

Appendix XXI (cont'd)

COUNTY	SHEEP NUMBERS 1967/68	1968/69	1969/70	AVERAGE NUMBERS 1967/70	PRODUCTION ESTIMATES Wool (1) (lbs)	Wool (2) (Bales)
Geraldine	661,249	670,179	672,439	667,956	7,815,085	22,725
Levels	442,523	443,544	412,709	432,925	5,065,223	14,729
MacKenzie	777,112	790,727	791,535	766,458	8,967,559	26,076
Waimate	1,133,622	1,127,134	1,100,373	1,120,376	13,108,399	38,117
Waitaki	982,244	1,016,685	1,030,541	1,009,823	11,905,813	34,620
Waihemo	248,312	255,360	264,767	256,146	3,022,523	8,789
Waikouaiti	192,360	195,392	201,449	196,400	2,317,520	6,739
Peninsula	44,897	45,307	46,388	45,531	537,266	1,562
Taieri	470,729	490,300	523,620	494,883	5,839,619	16,981
Bruce	736,196	733,633	768,040	745,956	8,802,281	25,595
Clutha	1,448,243	1,464,871	1,496,752	1,469,955	17,654,160	51,335
Tuapeka	1,078,407	1,125,044	1,175,697	1,126,383	13,527,859	39,337
Maniototo	641,629	675,505	679,221	665,452	7,852,334	2,283
Lake	402,769	392,443	388,530	394,580	4,697,475	13,659
Vincent	696,536	714,595	729,601	713,577	8,420,209	24,484
Southland	5,214,980	5,347,060	5,598,437	5,386,826	74,876,881	217,729
Wallace	2,178,010	2,265,059	2,365,603	2,269,557	31,546,842	91,733

1. Average sheep numbers multiplied by average production per sheep (see Appendix XV).

2. Based on a bale containing 343.9 lbs (the average bale weight during 1969/70 season).

SOURCE: Department of Statistics Sheep Returns 1968, 1969, 1970; New Zealand Meat and Wool Boards' Economic Service Annual Review of the Sheep Industry 1968/69, 1969/70, 1970/71.

Appendix XXII

AVERAGE WOOL PRODUCTION PER SHEEP, 1969/1971

AREA	AVERAGE PRODUCTION 1968/69 (lbs.)	1969/70 (lbs.)	1970/71 (lbs.)	1969/1971 AVERAGE (lbs.)
Christchurch	11.8	10.9	11.5	11.4
Timaru	12.0	11.1	12.2	11.8
Dunedin	12.0	11.5	12.0	11.8
Invercargill	13.4	14.1	14.3	13.9
New Zealand	12.1	12.1	12.2	12.1

SOURCE: New Zealand Meat and Wool Boards' Economic Service, Annual Review of the Sheep Industry 1968/69, 1969/70, 1970/71.

Appendix XXIII

INLAND TRANSPORT RATES FOR WOOL

Dollars per Bale[1]

	DESTINATION					
ORIGIN	Picton	Christchurch	Timaru	Dunedin	Invercargill	County "Centre"
Marlborough	0.65	2.73	3.27	4.30	5.20	0.84
Awatere	1.13	2.50	3.20	4.07	5.00	0.54
Kaikoura	1.76	1.97	2.87	3.73	4.70	0.54
Waimea	1.66	3.27	3.93	4.80	5.70	0.46
Golden Bay	1.97	3.47	4.14	5.00	5.90	0.86
Buller	3.40	2.80	3.47	4.30	5.20	
Inangahua	4.00	2.55	3.13	4.00	4.30	
Westland	4.07	2.63	3.20	4.07	4.30	
Amuri	2.87	1.60	2.63	3.53	4.50	0.54
Cheviot	2.13	1.60	2.63	3.53	4.50	0.54
Waipara	2.67	1.22	2.34	3.44	4.30	0.54
Ashley		1.15				1.15
Rangiora		0.98				0.98
Eyre		0.77				0.77
Oxford		1.15				1.15
Malvern		1.15				1.15
Paparua		0.44				0.44
Waimairi		0.44				0.44
Heathcote		0.44				0.44
Mt Herbert		0.44				0.44
Akaroa		1.15				1.15
Wairewa		0.98				0.98
Ellesmere		0.98				0.98
Ashburton	3.27	1.30		2.87	3.80	0.55
Geraldine			0.77			0.77
Levels			0.77			0.77
MacKenzie			0.77			0.77
Waimate			0.77			0.77
Waitaki	3.67	2.63	1.60	1.97	3.13	0.53
Waihemo				1.05		1.05
Waikouaiti				0.85		0.85
Peninsula				0.62		0.62
Taieri				0.84		0.84
Bruce	4.70	3.20	2.50	0.60	1.81	0.60
Clutha	4.90	3.47	2.80	0.60	1.38	0.60
Tuapeka	5.10	3.60	2.90	0.60	2.39	0.60
Maniatoto	5.00	3.53	2.87	0.85	2.80	0.85

.... continued

Appendix XXIII - continued

	DESTINATION					
ORIGIN	Picton	Christchurch	Timaru	Dunedin	Invercargill	County "Centre" (2
Lake	5.50	4.00	3.33	0.85	3.27	0.85
Vincent	5.50	4.00	3.33	0.85	3.27	0.85
Southland					0.81	0.81
Wallace	5.70	4.30	3.60	2.70	1.24	0.81
Picton		2.73	3.40	4.30	5.20	
Lyttelton		0.60	1.87	3.00	3.93	
Timaru Port		1.76	0.27	2.08	3.20	
Otago Port		2.93	2.08	0.27	2.18	
Bluff		4.00	3.33	2.39	0.65	

(1) Effective at 4 November 1971. Movements under 40 miles in distance are assumed to move by road transport.

(2) The New Zealand Wool Board calculated the average distance each bale of wool must travel in reaching its county's "centre". Rates have been based on these distances.

SOURCE: Railway charges taken from Alteration to Scale of Charges, New Zealand Government Railways, Supplement to the New Zealand Gazette, 4 November 1971. Road transport charges supplied by Ministry of Transport, (includes 5½ per cent increase as from 15/5/71).

Appendix XXIV

PORT THROUGHPUT CHARGES

PORT	WHARFAGE[1]		HARBOUR IMPROVEMENT		LOADING COST[2]		TOTAL	
	Frozen Meat (Ton)	Wool (Bale)	Frozen Meat (Ton)	Wool (Bale)	Frozen Meat (Ton)	Wool (Bale)	Frozen Meat (Ton)	Wool (Bale)
Picton	0.50	0.10	-	-	n.a.	1.35	n.a.	1.45
Nelson	1.00	0.50	0.25	0.25	6.90	1.44	8.15	2.19
Lyttelton	0.37	0.37	0.22	0.04	9.25 6.97[3]	1.04	9.84 7.85[3]	1.45
Timaru	0.88	0.41	-	-	8.42	0.86	9.30	1.27
Dunedin	0.70	0.35	0.25	0.08	8.44	0.84	9.39	1.27
Port Chalmers	0.70	0.35	0.25	0.08	10.29 6.44[3]	1.00	11.24 8.18[3]	1.43
Bluff	1.74	0.65	-	-	8.36	0.86	10.10	1.51

n.a. - not available.

(1) Effective as at 1 January 1971.
(2) Average Stevedoring Cost
(3) Using All-weather Mechanical Loaders.

SOURCE: Waterfront Industry Commission Annual Report and Statement of Accounts for the 9 months Ended 30 September 1970, Harbour Board By-Laws and Schedule of Charges.

Appendix XXV

TRANSPORT COSTS INCURRED IN MOVING WOOL FROM COUNTY TO SHIP, WHEN HARBOUR IMPROVEMENT RATE IS EXCLUDED

1967/1970 Production Estimates

PORT COMBINATIONS	COST (dollars)	PORT COMBINATIONS	COST (dollars)
One South Island Port		Two South Island Ports	
Lyttelton	4,963,123	Lyttelton Otago	3,826,125
Timaru	4,351,992	Lyttelton Bluff	3,784,951
Otago	4,285,864		
Bluff	4,875,138	Timaru Otago	3,774,270
Wellington Lyttelton	4,952,322	Timaru Bluff	3,646,563
Wellington Timaru	4,321,523	Wellington Lyttelton Otago	3,835,843
Wellington Otago	4,197,070	Wellington Lyttelton Bluff	3,774,151
Wellington Bluff	4,670,495	Wellington Timaru Otago	3,743,801
All Ports Included	3,207,400	Wellington Timaru Bluff	3,616,094

Appendix XXVI

RAILWAY CHARGES FOR THE MOVEMENT
OF FROZEN MEAT TO SOUTH ISLAND PORTS

Dollars per Ton

FREEZING WORKS LOCATION	PORT					
	Nelson	Picton	Lyttelton	Timaru	Otago	Bluff
Stoke	2.29	12.28	20.50	23.44	28.34	33.48
Picton	12.03	2.09	18.55	21.48	26.29	30.91
Kaiapoi	19.52	17.57	3.93	12.78	19.20	24.09
Belfast(2)	19.85	17.57	2.92	12.53	19.20	24.09
Islington	20.50	18.55	2.85	11.70	18.55	23.44
Fairfield	21.81	19.85	8.85	8.31	16.57	22.13
Smithfield	23.44	21.48	12.28	2.09	14.05	20.50
Pareora	23.77	21.81	12.78	2.36	13.54	20.18
Pukeuri	24.75	23.11	14.80	7.76	11.38	18.87
Burnside	27.83	25.77	18.87	13.79	2.64	14.80
Finegand	29.88	27.83	20.50	16.32	9.54	12.53
Mataura	31.43	29.37	22.46	18.87	12.78	8.03
Makarewa	32.97	30.91	23.77	20.18	14.80	4.77
Lorneville	32.45	30.91	23.44	20.18	14.55	3.93
Ocean Beach	32.97	31.43	23.77	20.50	15.06	2.69

SOURCE: Alteration to Scale of Charges, New Zealand Government Railways, Supplement to the New Zealand Gazette, 4 November 1971.

Appendix XXVII

TRENDS IN COOK STRAIT RAIL FERRY AND RAIL/AIR CARGO MOVEMENTS, 1963/1970

YEAR	MOTOR VEHICLES (1) (Numbers)	RAIL FERRY FREIGHT TRAFFIC (Deadweight Tons)	RAIL/AIR FREIGHT TRAFFIC (Manifest Tons)
1963	21,474	48,922	25,286
1964	37,362	143,655	21,131
1965	45,592	180,650	22,017
1966	51,396	215,480	27,009
1967	60,690	294,933	20,150
1968	66,067	343,791	14,580
1969	76,067	421,064	16,277
1970	89,055	507,281	23,936

(1) Passengers' Motor Vehicles plus Lorries and Trade Cars.

SOURCE: Marlborough Harbour Board and New Zealand Railways Department.

Appendix XXVIII

TRENDS IN INTER-ISLAND COASTAL SHIPPING FREIGHT MOVEMENTS, 1964/1970[1]

Manifest Tons

YEAR	HARBOUR BOARD						TOTAL
	Nelson	Lyttelton	Timaru	Oamaru	Otago	Southland	
1964	132,292	562,594	80,729	31,543	178,120	67,341	1,052,619
1965	137,411	570,403	69,269	31,404	170,752	66,413	1,045,652
1966	150,058	618,678	81,406	31,070	171,294	67,736	1,120,242
1967	117,044	739,055	82,370	34,104	143,238	60,234	1,176,045
1968	89,215	734,650	74,709	29,186	144,664	52,401	1,124,825
1969	67,890	728,123	63,702	33,422	145,361	51,690	1,090,188
1970	65,053	744,166	42,842	21,384	139,992	76,785	1,090,242

(1) Motor Spirits and Petroleum Products are Excluded.

SOURCE: Taken from Harbour Board Annual Reports, Trade Statistics and Shipping Manifests.

Appendix A

REGIONAL MULTIPLIERS

The multiplier is a figure illustrating the marginal effect of a change of one economic variable upon another economic variable, of which the first economic variable is a component. Hegeland(1966) has traced the multiplier concept to the late nineteenth century. It was popularised by R.F. Kahn in the 1930's in connection with the development of an employment multiplier. J.M. Keynes extended the concept by developing the investment multiplier.

The Keynesian analytical framework recognises four principal types of income-generating activities: a) Production of goods and services for consumption; b) Private and public investment in real capital; c) Local government expenditures; and d) Exports of goods and services. Total national income is then expressed as

$$Y = C + I + G + (X - M)$$

where Y = national income
C = consumption
I = investment
G = government expenditure
$(X-M)$ = export earnings

This income equation may be rewritten to apply to regional analysis as

$$Y = aC + bI + cG + g(X - M)$$

where the parameters a, b, c, and g represent the regional income generated from each amount of expenditure in each

category. (This assumes that there is no feed back from other regions). Setting consumption as a function of income

$$C = kY$$

where k equals the regional propensity to consume, the equation for income may be rewritten as

$$Y = akY + gX$$

where investment and current government expenditure are autonomously determined. But since

$$C = kY$$

$$Y = akY + gX$$

and therefore

$$Y = \frac{gX}{(1 - ak)}$$

where the factor $\frac{1}{(1 - ak)}$ is the regional multiplier, and it is the result of the chain of spending that results from the injection of outside money into the regional economy.

Appendix B

THE OUT-OF-KILTER ALGORITHM[1]

The out-of-kilter algorithm solves the problem of determining the minimal cost circulation through a capacitated network. It may also be used to compute the maximum flow possible between any two nodes in a costless, capacitated network, and the shortest path between pairs of nodes in a network.

The network is assumed to be characterised by nodes, i; arcs between the nodes (i, j); flow across the arcs, x_{ij}; unit costs of flow across these arcs, c_{ij}; as well as lower bounds on the flow across these arcs, l_{ij}, and upper bounds, u_{ij}. The algorithm computes the flows between particular nodes, x_{ij}, which minimize total cost:

1. $\sum_{i}\sum_{j} c_{ij} x_{ij}$ for all i and j;

but these flows must satisfy a set of constraining conditions -

2. $l_{ij} \leq x_{ij} \leq u_{ij}$ for all i and j. This necessitates that the flow, x_{ij}, is in accordance with the arc capacity restraints, and

3. $\sum_{j} x_{ji} - \sum_{j} x_{ij} = 0$ for all i. This in turn means that in a circulation, what arrives at a node must also leave the node.

The flow, x_{ij}, which satisfies the flow constraints (2), and the conservation of flow requirement (3), is called <u>feasible</u>. In computing the minimal cost feasible circulation the algorithm operates with both arc costs, c_{ij}, and node prices π. The node price π_i, is the price of a unit of a particular commodity at node i. A <u>net arc cost</u>, $\overline{c}_{ij}$, is

defined as:

4. $\overline{c_{ij}} = c_{ij} + \overline{\Pi_i} - \overline{\Pi_j}$

Thus $\overline{c_{ij}}$ represents the total cost of transporting one unit from node i to node j. It is found by comparing the cost of retaining a unit of the commodity at i, with the cost of moving it to node j. But in moving the unit from i to j the commodity price at i, $\overline{\Pi_i}$, is "lost" and an actual transport cost, c_{ij}, is incurred. If the sum of these cost proves to be greater than the commodity price at j, $\overline{\Pi_j}$, then it is not profitable to transfer the unit from i to j, that is, $\overline{c_{ij}}$ will be positive. If the unit at node j costs more than at i, plus the transportation cost c_{ij}, $\overline{c_{ij}}$ will be negative and it would be profitable to all concerned to move the unit from i to j. If $\overline{c_{ij}} = 0$, this would mean that the unit commodity's value at j was exactly balanced by its value at i plus the transportation cost ($\overline{\Pi_i} + c_{ij}$), and the system would be indifferent to the commodity moving from i to j.

The limitations placed on the permissible flow level, provided by the conditions in (2), combined with the possible levels of total system costs (4), yield the following conditions that will be satisfied by an optimal solution to the minimal cost circulation problem:

5. If $\overline{c_{ij}} < 0$ then $x_{ij} = u_{ij}$

6. If $\overline{c_{ij}} = 0$ then $l_{ij} \leq x_{ij} \leq u_{ij}$

7. If $\overline{c_{ij}} > 0$ then $x_{ij} = l_{ij}$

These equations summarise the preceeding discussion. For example, equation (5) states that when the net arc cost $\overline{c_{ij}}$ is negative, that is, it is profitable to move the commodity from i to j, flow along this arc ought to be as large as possible - equal to the upper capacity limit. The out-of-kilter

algorithm is designed to calculate the flow pattern which satisfies these requirements.

Arcs which do meet the optimality conditions, (5), (6) and (7), are defined as "in-kilter". Conversely arcs not satisfying these requirements are "out-of-kilter". Such out-of-kilter arcs can be in one of two states:

(a) They may be feasible but not optimal. These arcs have flows satisfying (2), but not (5), (6), and (7).

(b) They may be infeasible. In this situtation flow is either below the lower or above the upper bounds.

Associated with any state that an arc may be in is a non-negative integer called the kilter number of that arc.[2] Arcs having a kilter number of zero are defined as in-kilter, while out-of-kilter arcs have positive kilter numbers - indicating either the infeasibility of the arc flow, or the degree to which the optimality properties set out in (5), (6), and (7) are not satisfied. Every arc is assigned a kilter number.

The algorithm operates by selecting an out-of-kilter arc and rearranging the flows through the network in an attempt to reduce the kilter number of that arc to zero. Node prices may have to be increased to generate flows through a certain portion of the network. If the original problem was so formulated that it met the feasibility requirements, the algorithm would terminate with an optimal solution when the kilter number of all arcs were zero. This flow would be both feasible and optimal in terms of minimal costs.

Footnotes

(1) The description of the algorithm is drawn from Sinclair (1969,79-82), and Durbin and Kroenke (1967).

(2) Gauthier(1968,107) lists the three states that in-kilter arcs, and the six states that out-of-kilter arcs may be in.